MALCOLM E. BURNS   FLOOD CONTROL DEPT.

FLOOD PROBLEMS

IN SANTA CLARA COUNTY

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County Surveyor's Report.

County Surveyor's Office,
San Jose, D[illegible].

Hon. John A. Brewster, Surveyor General:—

Sir: I have the honor to submit the following Report from this office.

The County of Santa Clara may be generally described as situated about 30 miles from the Pacific coast, and bounded on two sides by the summits of mountain ranges, the Coast Mountain on the east, and the Santa Cruz Range on the southwest. The valley lying between, which constitutes nearly one half of the area of the county, is about fifty miles long, and extends from the Pajaro river, which forms a portion of the southern boundary, to the Bay of San Francisco, in a direction nearly parallel to the coast, and by compass N. 34° W. true course. At the northern extremity, in the vicinity of this city, the valley is from 12 to 15 miles wide. It becomes narrower at about midway, and is nearly intersected by several ranges of low hills, and the southern portion has an average width of 6 miles. The county is bounded on the north by the counties of Alameda and San Mateo, on the south by Monterey county, on the west by the county of Santa Cruz and on the east by the counties of [redacted] and San Joaquin. All of which boundaries have been surveyed and established, if I mistake not, except those adjoining the counties of Monterey, [redacted] and San Joaquin. The former line should be surveyed as soon as possible, as there is a large section of the country, in the vicinity of Pacheco's Pass which is claimed by both counties making it difficult for the County Assessor to make a correct assessment.— The line of the eastern boundary follows the summit of the Coast Mountains, and runs through an unsettled mountainous district, a distance of 30 or 40 miles.

The lines and topography of this county, as shown upon the official map of the State are somewhat incorrect. An important error is mentioned by Mr. Lewis in a former report from this office, in regard to the Salsipuedes Creek, which is represented as rising on the east side of the Santa Cruz Range, and flowing a long distance through this county, when really no part of it is within our boundaries. The error is small, however, compared with the many discrepancies to be detected in that portion of the map relating to the northern part of the State. It is evident that a new State map should be made as soon as practicable. If some compensation could be allowed County Surveyors for what data they might be able to furnish towards the compilation of a State map, they could take advantage of many facts and figures accessible to them, which, further than is required by law, they cannot afford to collect for nothing.

I am at present collecting reliable data from the U. S. Coast Survey Reports, U. S. Township plats and maps, field notes, &c., in this office, from which, together with what surveys I may see fit to make at my own expense, I expect to be able during the coming year, to compile a correct topographical map of this county.

The area of Santa Clara County has been estimated at 1000 square miles, not less than one half of which is valley land. Of this amount probably 60,000 acres are enclosed, about one half of which is under cultivation. I omit Agricultural statistics as they have been furnished you by the Assessor. The wheat crop has suffered severely for two seasons past from the excessive drouth; in portions of the valley not one tenth of the grain sown, has been harvested, while in many lower localities, and where irrigation, by means of artesian wells and otherwise has been practicable, the yield has been good. The smut has injured many fields of grain, but the principal cause of the short crops has been the very dry winter and spring of this year, following the equally dry season of last. The capacity of the soil of the Santa Clara Valley, to produce abundantly has never been doubted. Notwithstanding the disastrous effects of two successive dry seasons, to most of our farmers, there is every confidence expressed that there will be sufficient rain the coming winter, to enable them to make up for past deficiencies, [illegible] that winter [illegible] following [illegible] amount of rain that has fallen the present month equals, it is said, that which fell at the same period in the exceedingly wet winter of 1849.

But provided that a great quantity of rain during a winter, proves to be an exception to the general course, but few localities in this valley will ultimately prove to be unproductive. Irrigation will be more generally resorted to, both by means of artesian wells, and by bringing the mountain streams upon the plains. Advantage will be taken of the rains that do fall, by sowing earlier, or deeper or by various different methods which experiment shall suggest. The productiveness of the soil in favorable situations, is attested by the records of the several Agricultural and other Fairs which have been held throughout the State for a few years past. They show a decided superiority in size and quality of fruits and vegetables grown in this county, over those of any other section.

Through the politeness of Judge Daniels, of this city, I have been placed in possession of valuable statistics in relation to Nurseries, Orchards and Vineyards, in this county, only a few general items of which I will give, as the details were included in the Report of the Assessor. The aggregate number of bearing fruit trees, of different varieties is upwards of 70,000, and about 35,000 bearing grape vines. There are over [illegible]0,000 fruit trees and vines, and 56,000 shade trees in Nursery.

It is estimated that not less than 1,000 acres are occupied in the rearing of fruit trees, vines and the different kinds of small fruits, strawberries, currants, gooseberries, raspberries, etc., not enumerated, exclusive of the small orchards and vineyards attached to the gardens of private residences. Wine has been manufactured to some extent this season.— Many are proposing to engage largely in that enterprise, making it probable that, owing to the adaptation of the soil to the culture of the grape, we shall soon rival Los Angeles in the production of wine.

Bees have been successfully introduced of late, and are found to thrive and make honey beyond all expectations, considering the peculiar nature of the climate.

Alkaline soils are to be met with in some places in this valley, so strongly impregnated as to be unfit for cultivation. Lands of this character are generally found about the middle of the valley and along the banks of the Coyote river, sometimes in large tracts, but more frequently in small isolated spots. There are several hundred acres of such lands, and whenever it becomes an object, they can be reclaimed, undoubtedly, by proper management and some expense. It has recently been discovered by Mr. Prevost, of the San Jose Nursery, that the Sugar Beet and Asparagus, flourish in such soils, as well if not better, than in any other.

There are no "swamp or overflowed lands," in this county, except the salt-marshes bordering upon the San Francisco Bay. This area has been estimated at 20 square miles. They are covered by high tides, and are generally considered valueless for ordinary purposes at the present time.

The Coast Mountains.—I adopt the names recommended by Dr. Trask, State Geologist, in refering to the mountains in this vicinity,—which form our eastern boundary, particularly their western slopes, have but little timber, except in the gulches. They are covered with wild oats, and afford an excellent range for Stock; and where it is not too steep to plow, grain can be raised with as little water as in the valley. They are at this time assuming a green spring like appearance, from the recent rains. The average height of the summits of these mountains is probably less than 2000 feet.

The Santa Cruz Range, on the southwest, are more lofty, and are covered, except the foot-hills, with an almost impenetrable growth of chapparal. There are several peaks in this range, which have an elevation of nearly 4000 feet above the tide. Many fine streams of water have their rise in these mountains, furnishing power for several saw mills and flouring mills, but [illegible] for all seasons of the year. This range also affords an inexhaustible supply of Redwood timber. There are 12 saw mills, three driven by steam and the balance by water power, which saw annually upwards of 5,000,000 feet of lumber; one steam saw mill alone, that of Mr. Boddish, saws 300,000 feet per month, working 12 hours per day.

There is no pine, or any other timber in the County, with the exception of two or three varieties of oak, which grow principally in the valleys, and form what are termed in the western country *Oak openings*, which are not close enough together to prevent the growth of grass and have the appearance from a distance, of orchards. The white oaks is the most common although there are many groves of the beautiful Evergreen, or Live oak, which here attains a vigorous growth, and adds much to the natural beauty of the scenery. The sycamore also grows to a great height along the banks of the creeks. The cotton wood, willow, and other trees of like species, are found in wet places, and along the small streams. None of these trees furnish timber of a good quality; all that is used in the manufacture of wagons, plows, etc., is necessarily brought from abroad.

There are no navigable streams in this county, unless the tide sloughs, which intersect the salt marshes, may be so termed.

The manufactories in this county, are principally those in which wagons, plows, etc. are made, in connection with the blacksmithing business. There are perhaps 10 of these establishments employing from 2 to 10 hands each. At the town of Santa Clara, about 500 superior steel plows were made this year, also heavy and light wagons and buggies of an excellent quality. There are also other places in the county where such business is carried on.

One Iron Foundry, connected with which is a machine shop, at San Jose has turned out 100,000 lbs. castings this year.

There are 10 flouring mills, 3 run by steam, and the balance by water power, having 25 run of stones in the aggregate and capable when worked to their full capacity, of making 750 barrels of flour per day.

I have been unable to obtain a correct account of the amount of capital invested in manufacturing and mercantile pursuits. I estimate that those enumerated together with many smaller manufactories, of saddles, harness, leather, boots, clothing, lime, bricks, &c., inclusive, require the investment of not far from $1,000,000, one third of which sum is devoted to mercantile purposes.

The celebrated Quicksilver Mine of New Almaden is in this county, situated about 12 miles from this city, upon the N. E. slope of a spur of the Santa Cruz Range. The mine was first opened by Andres Castillero, in October 1845, and has been successfully worked since that time. The company as now organized took charge in 1850. It has been alluded to in official reports and other publications, as the richest in the world; and although that statement remains undisputed, in order that a more definate estimate may be arrived at, I deem it not improper to give a copy of the reply of Capt. Halleck the Director General, to my application for the statistics of the mine:

SAN FRANCISCO Oct. 11, 1857.

Charles T. Healy, County Surveyor,
San Jose.

Sir: Your note of the 10th inst., asking for certain information with respect to New Almaden, is duly received.

The average annual production of the Quicksilver at the Mine of New Almaden is 1,087,000 lbs. The ore reduced within the last year has yielded a little over 18 per cent. of metal. The annual cost of the working is about $254,000. The nett value of the quicksilver is about 37 cents per lb. The number of workmen employed is variable; at present the whole number of employees is about two hundred.

The quicksilver is put up in wrought iron flasks—75 lbs. in each—and a large portion of it transported to the interior of Mexico, Chili and Peru for market.

If [illegible] of [illegible] &c., [illegible] fact, that most [illegible] M[illegible] America are on long credits, [illegible] capital necessarily [illegible] waiting for returns from [illegible] is seen that the profits [illegible] Company working the Mine [illegible] compared with the us[illegible] capital in California. [illegible] numerous absurd reports [illegible] with respect to the prod[illegible] of the New Almaden M[illegible] frequently appeared in the ne[illegible]rs, which I have never deemed wo[illegible] correcting; but I am always ready to furnish all desirable information to those who ask it for a proper purpose.

Very respectfully,
Your ob't serv't,
H. W. HALLECK.

There are also in this county many other points where cinnabar has been discovered, but no other mine has been opened and worked by a permanently organized company, with the exception of the Guadalupe Mine, at present under the supervision of Eben Faxon, Esq., to whom I am indebted for information relative to it.

The work of taking out metal from this mine was commenced by the present owners early in 1856, and it is not yet in full operation. New machinery has recently been erected with which to work the mine in a proper manner. Upwards of $70,000 has been expended in working the mine during the past year, and a yield of 90,000 lbs. of quicksilver realized. The number of hands at present employed is about forty. This mine is situated in the same range of mountains as that of New Almaden, and is about 4 miles from the latter.

Limestone abounds in the low hills of the same range; extensive quarries of which have been opened, and large kilns successfully burned at 5 or 6 different places during the last 7 years. Only one is at present in operation. It furnishes about 500 casks of lime per month, of an excellent quality. Specimens of coal and silver ore have been exhibited, purporting to have come from the mountains west of the valley, but no capital has been invested in opening the veins or deposits, nor is there sufficient evidence of their existence to warrant great expense.

I will add while on this subject, that a large bank or bluff of Alum, or earth strongly impregnated with alum, has been discovered in the cañon of the Aguaja creek, in the mountains east of this city. No attempt has been made as yet to realize any profit from it; the low commercial value of the article not offering sufficient inducement for the necessary outlay of capital at present.

The subject of Artesian Wells deserves more than a passing notice. The first artesian well in this county was bored in the fall of 1853, since which time their number has increased to upwards of 400, having an average depth of 150 feet. There are, perhaps, 10 or 15 wells within a few miles of this city, from 250 to 400 feet deep, which throw a stream of water, from 2 to 5 feet high with a force sufficient to prevent stones weighing from half a pound to 2 pounds from sinking when dropped into the pipes. Very many wells flow only an inch above the pipe, some still less, while the balance vary between the heights stated. The expense of boring an artesian well is about two dollers per foot. The pipe generally used is of No. 16 sheet iron, from 6 to 8 inches in diameter, driven to the whole depth of the well as fast as the boring progresses. It is not often that the boring of a well has to be discontinued, on account of not finding water; a stream is most always obtained throughout this valley, at a depth varying from 50 to 450 feet. The water from these wells is generally warmer than surface water, and, in some instances, until it has been exposed for a short time to the air, unpleasant to the taste; owing undoubtedly, to the gases absorbed in the subterranean passages. Statements have been made as to its containing salts and alkaline matter, making it unfit for irrigation, or culinary purposes, which have proved to be incorrect. The water is as good as that obtained from usual

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FLOOD PROBLEMS

IN SANTA CLARA COUNTY

monograph no. 3

COUNTY OF SANTA CLARA PLANNING COMMISSION
COURTHOUSE
SAN JOSE 13, CALIFORNIA 1952

COUNTY OF SANTA CLARA
PLANNING COMMISSION

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COUNTY COUNSEL
E. O. WOOL
BOARD OF SUPERVISORS
KARL J. BELSER
DIRECTOR-SECRETARY

COURT HOUSE
SAN JOSE 13, CALIFORNIA

October 20, 1952

Mr. Carroll Wentz, Chairman
Santa Clara County Planning Commission
Court House
San Jose, California

Dear Mr. Wentz:

I am pleased to transmit herewith Monograph Number 3 entitled, "FLOOD PROBLEMS IN SANTA CLARA COUNTY". Many problems must be solved in order that the best and ultimate development of Santa Clara County may be achieved. This report is one of a series dealing with such problems, and has been prepared in cooperation with the Santa Clara County Flood Control District.

This study, combining information obtained from original surveys and previous reports by the Planning Commission and others, is divided into three parts:

Part I:	Land Inundation
Part II:	Contributing Factors: the soil and subsurface drainage
Part III:	Appendix

The information concerning land inundation has been obtained from various local sources, and was checked against aerial maps and flood conditions existing during the winter of 1951-1952.

There are three supplements to this report, all of which have been published separately in another book. The first supplement contains the tabulations which support the information in Part II. The second supplement contains previous reports which deal with Land Inundation, published by the Planning Commission and other interested agencies. The third supplement contains the Santa Clara County Flood Control Act.

Respectfully submitted,

Karl J. Belser

KARL J. BELSER, Director-Secretary

KJB:jp

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Appreciation for the great majority of photographs and captions used throughout this report is extended to the San Jose Mercury-News. Other contributors were the Par Photo Company, San Jose; Palo Alto Times, Palo Alto; Studio D'Art, Los Altos; and the City Engineer, City of Santa Clara, California.

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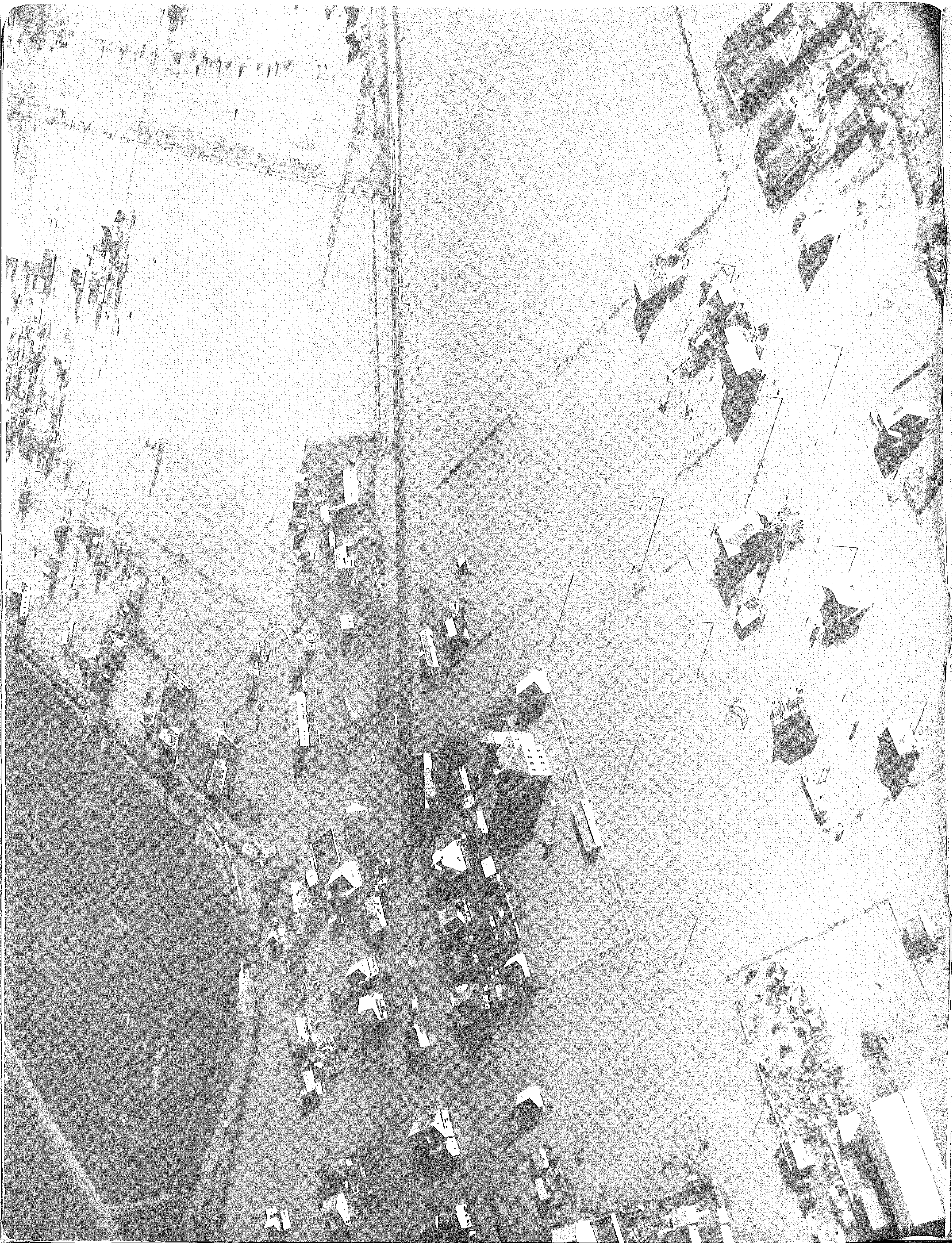
Part I: Land Inundation



Inundation of Alviso, California, January 1952. South Bay community in grip of muddy flood waters at peak of deluge. City became a ghost town, its citizens evacuated by Red Cross disaster workers to higher county areas. Plight of suffering city was worst in many years.

Introduction

The drainage problem of Santa Clara County is concerned with both surface and underground waters. In this section of the report both the surface drainage and storm runoff problem will be analyzed.

In recent years the problem of land inundation has been brought to public attention by a considerable number of farmers as well as by home owners in new subdivisions and business firms. All persons involved have petitioned the County for relief, on the basis that:

> Land Inundation is an old problem that has been temporarily forgotten during years of little rainfall.
>
> Drainage is not an individual or a local problem. Like all other water problems, drainage and flood control must be studied and planned for on a watershed or valley-wide basis.
>
> An adequate drainage and flood control system has become of vital concern to both the urban dweller and the agriculturist.

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1. See Part 2, "Contributing Factors: The Soil and Subsurface Drainage," for an analysis of the characteristics of underground drainage.

A little channel improvement has been completed. Because the program has not had a comprehensive approach, drainage and flood control works have shifted the critical drainage problem from one point to a new point.

The conservation dams constructed in the hills have afforded some relief from flooded conditions. However, there is always the danger of critical flooding arising from the overspill of full reservoirs, and the build up of storm waters originating on the valley floor.

It is true that a better control over subdivisions has now been established and that some drainage facilities are being constructed by the County in the Alum Rock-Evergreen area. Again this is only the spot or individual approach to a most critical problem.

Because the coordinated approach has been lacking, the County is little better off today than twenty years ago, excepting for the flood checking features of the conservation dams and the drainage structures in the Alum Rock-Evergreen area. In the twenty years, large areas of North Santa Clara Valley have become urbanized. Thus, the drainage problem today is at its most critical stage.

Highlights

Flood control is a dual phased operation dealing with (1) the control of storm waters originating in the mountains, and (2) the control of storm waters originating on the valley floor. The first phase is now being studied by the Santa Clara Valley Water Conservation District and by the State Water Conservation Board. This report deals primarily with the latter phase.

Conservation works cannot be used successfully to control flood and storm runoff waters originating on the valley floor.

Before the valley was settled large land areas in swamps were natural holding ponds which collected and held storm runoff waters until they could reach the San Francisco Bay and the Pajaro River.

The drainage problem is man-created:

> Swamps and natural drainage channels have been filled in.
>
> Excessive pumping from the underground table indirectly caused land subsidence adjacent to San Francisco Bay.

Land subsidence has caused a change in the gradient of the valley floor. This is because the inland areas have subsided at a faster rate than the tide lands. The result has been to flatten large areas around San Jose and Mountain View and to steepen areas just south of these new flat spots.

Subdivisions of the valley floor has increased the storm runoff and is overtaxing present drainage structures.

In general the frequency of flood producing storms follows the twenty year rainfall cycle.

In the future the greatest flood danger will be from any one or a combination of any of the following hydrographic conditions:

Overspill of conservation reservoirs in exceedingly wet winters.

Saturation of the soil by continuous rainfall followed by a flood producing storm.

Flash floods in highly urbanized areas which overload the storm drainage systems.

In the tidal areas high runoff of surface waters combined with high bay tides cause a ponding which inundates large land areas on the flat plain adjacent to the San Francisco Bay and the Pajaro River.

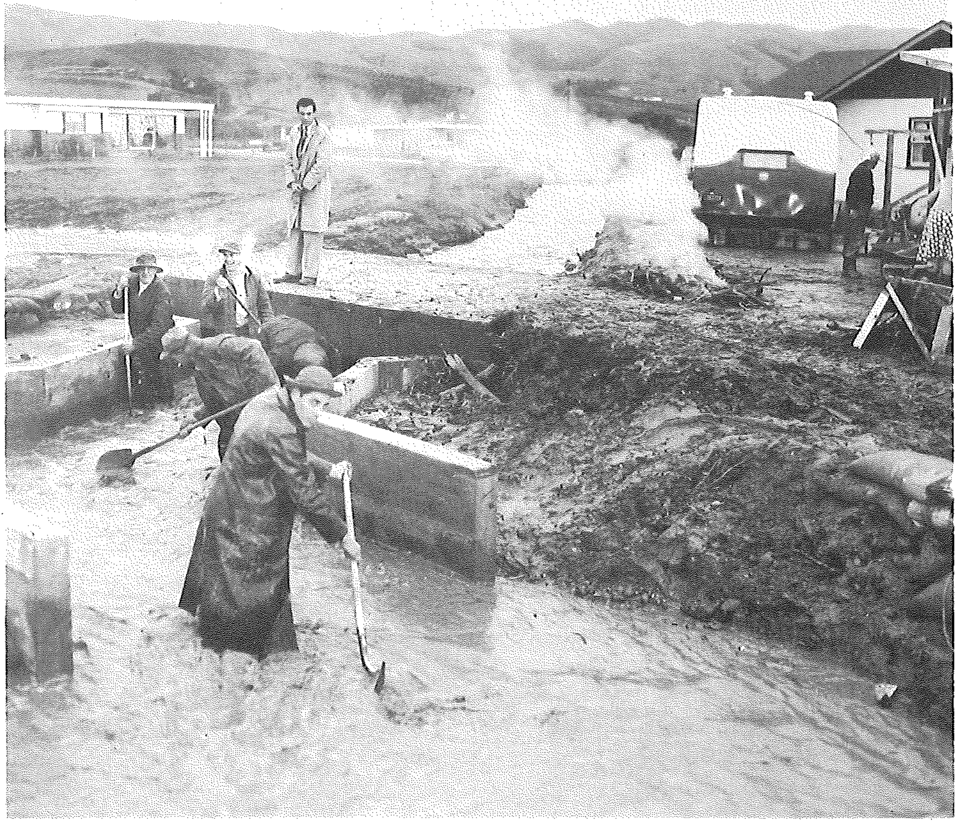
The design of drainage structures is in its formative stages.

Because hydrological engineering is a very specialized form of engineering, specialists are needed to design drainage structures and to prepare an overall drainage and storm control plan.

Incorrectly designed drainage structures contribute to flood conditions.

The increasing intensity of floods now makes obsolete drainage structures which were formerly considered adequate.

The principal physical factors contributing to flood conditions are uncontrolled surface waters, tidal flooding, high groundwater tables, clay and other impervious soils, and sinking of the valley floor. The condition is further aggravated by tidal dikes, roads which form inverted dams, and culverts of inadequate capacity.



Woodhaven, East San Jose, January 1952. Rains from Mt. Hamilton filled this little stream to overflowing.

North Babb Creek
at Meadow Lane

Action Taken Between 1940 and 1952

Early Recognition of the Problem

For several years there has been a recognition of the critical problem arising from storm runoff and flood waters in Santa Clara County. The County Planning Commission has been one of the agencies actively engaged in seeking a solution to this problem. Up to and including the early 1940's storm runoff drainage and flood control were considered local problems with the benefits accruing to agriculture greater than any damages caused by flood waters.

Lack of Local Interest

Early reports by the U. S. Corps of Army Engineers were either dropped because of lack of local interest or, when published, were turned down by the local agricultural community because the benefits to be received were considered too costly.[2]

Beginning of Urban Leadership

In the early 1940's both the City of Palo Alto and the County Planning Commission took action to find measures which would prevent recurrent floods. These floods were causing damage to crop and urban developments. The following chronological list has been taken from the minutes of the County of Santa Clara Planning Commission.

---

[2] See Army Engineer's 1944 Report "The Pajaro River," pp. 4, 5, 43, 44.

ACTION TAKEN

Palo Alto	1941	The City of Palo Alto held hearings in cooperation with Santa Clara County and the Army Engineers concerning the flood conditions existing on the Matadero and San Francisquito Creeks. (The Army Engineers report has been left unpublished.) Palo Alto did construct a tidal basin to impound storm runoff until it could flow into the bay at low tide.
Coyote and Guadalupe Rivers	1941	Congressman Jack Anderson and the San Jose Chamber of Commerce requested authority from Congress to have the Army Engineers conduct a survey of the flood conditions on the Coyote and Guadalupe Rivers.
Funds Made Available for a Reconnaissance	1943	The County of Santa Clara Planning Commission requested from and was granted by the County Board of Supervisors funds to conduct a County wide reconnaissance survey for the purpose of laying the ground work for a County wide storm water drainage system.
Reconnaissance Completed	1944	The County Planning Commission received the reconnaissance report from J. Winter Smith on the drainage problem and means for its solution.
Army Engineers Pajaro River Report	1944	In March of 1944 the Army Engineers submitted their survey of the Pajaro River and South Santa Clara Valley. The report stated: "The district engineer finds that neither the construction of works to provide complete flood protection in the Pajaro River Basin nor reservoirs to provide partial flood control with or without water conservation or drainage features is economically justified by the prospective benefits at this time. . . He also finds that reconstruction and extension of the existing levee near Gilroy (on the Carnadero) could be accomplished. . . " The report also stated that with a greater urban pattern, flood control would be a more critical problem.
Army Engineers 1944 Hearings	1944	The County Planning Commission in cooperation with the County Engineer submitted evidence of flood conditions on the Coyote and Guadalupe Rivers at the Army Engineers hearing. (The survey and report have been left unfinished by the Army Engineers due, they say, to the lack of local interest.)

1944 **Planning Commission's Eight Point Program**

The County Planning Commission submitted a report urging the County Board of Supervisors to do something about the critical flood conditions. The report stated in part:

> That a critical storm drainage problem existed,
>
> That no comprehensive storm water disposal plan existed,
>
> That such a plan was urgently needed,
>
> That the public health, safety, comfort, convenience and general welfare of the County required that the Board of Supervisors designate an agency to be responsible for the preparation and the carrying out of such a plan, and
>
> That the Board of Supervisors make an emergency appropriation in order to employ such competent engineering personnel as were needed to prepare such a comprehensive plan, and that these funds be used:
>
> > By the County Engineer to employ a consultant.
> >
> > By the County Engineer to add to his staff for the purpose of preparing engineering studies leading to a comprehensive storm water runoff disposal plan.

1944 **Official Postwar Improvement Program**

The County Planning Commission included in its Post War Capital Improvement Program, entitled "BLUEPRINT FOR THE FUTURE" a sum of $50,000 a year for a five year program. This program was adopted by the County. The program included the following terms:

> Straightening, deepening, widening, leveeing and clearing the existing creeks and maintaining them consistently in a condition of optimum efficiency by regularly organized county maintenance and equipment.

ACTION TAKEN

1944

Creation of bypasses to relieve flood waters and to drain the low ground after subsidence of the waters.

Construction of additional reservoirs in the hills in order to relieve flash flooding.

Control of artesian wells and wells with leaky casings to prevent excessive saturation of upper strata.

Construction of a channel to carry Silver Creek across the inundated area near Hillview.

Cleaning out the Pajaro River from its confluence with the San Benito River northeasterly to Bloomfield Road in order to increase its capacity and enable it to carry the drainage water developed in the area lying generally south of Morgan Hill.

Opening of the old drainage ditches from a point south of Morgan Hill to the system's junction with Llagas Creek east of Gilroy.

Strengthening the levee on the Carnadero Creek west of Gilroy and cleaning it from the state highway to its junction with the Pajaro River.

Construction of a drainage ditch across the low area southwest of old Gilroy to the Pajaro River.[3]

Reactivation

1949

The County Planning Commission took the following action after the near normal rainfall of the winter of 1948-49:

> July 1949. Held a conference with all the Engineers in the County to discuss the drainage problems. Twenty-eight persons attended this meeting at which reports previously prepared by Mark Thomas and others were presented.[4]

---

[3] The last four items were recommendations made in The Army Engineers report on The Pajaro River.

[4] See Supplement No. 2, Section 7.

Accepted the offer of the San Jose Engineers Club to prepare an advisory report concerning drainage problems. The report made the following recommendations: 1949

> that a critical storm water drainage problem existed,
>
> that steps be taken to alleviate this problem,
>
> that one County agency be made responsible for the provision of storm water drainage facilities, and
>
> that the same agency be authorized to prepare a Master Plan for storm water disposal in the critical unincorporated areas.

In November 1949 the Planning Commission transmitted to the Board of Supervisors a report incorporating all the work done at this date.

The County Planning Commission sent a follow-up letter in the fall of 1950 when a contract for cloud seeding was under consideration. In this letter the Commission stated the urgency of an adequate storm water and flood control program. The flood of 1951-52 pointed up the urgency and need with actual conditions.[5] 1950

Drainage District Established

At the regular session of the state legislature a county flood control district was established. With the exception of existing water conservation districts, which were not included, this district covered the whole county. This legislation permits the creation of flood control zones for purposes of assessment and taxation in order to more evenly spread the cost and benefits of drainage programs. 1952

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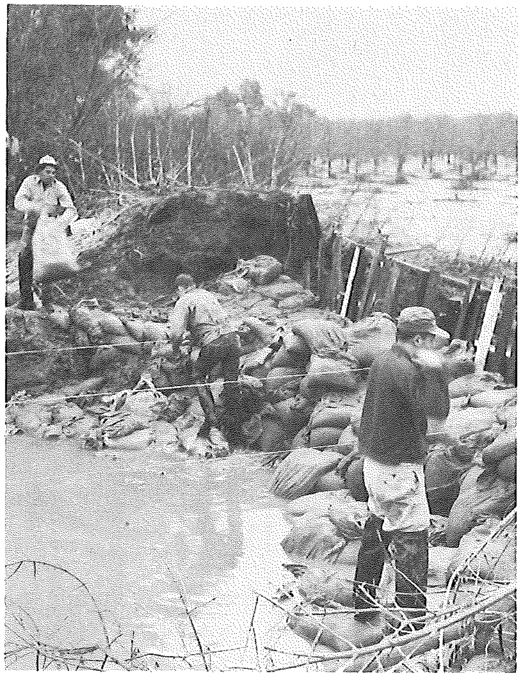
[5] See Supplement No. 2, Sections 5 and 6.



ACTION TAKEN

1952

At a special session of the state legislature the flood control act for Santa Clara County passed in 1950 was amended in order to establish a County-wide drainage district. This legislation now gives the County full legal right to prepare a comprehensive drainage plan for both incorporated and unincorporated County areas, and power to condemn land in these areas for the construction of flood control works. The water conservation district has given the power or right to approve the plans for flood control within their districts. This approval was given the conservation districts with their inclusion in the flood control district.[6]

The State Water Resources Board submitted a preliminary report on flood control in north Santa Clara Valley.[7]

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6. See Supplement No. 3 for "Santa Clara County Flood Control Act."
7. See Supplement No. 2, Section 1.

Progress Made

An Uncoordinated Approach

An evaluation of the work done since 1944 reveals that there has been an uncoordinated approach toward the solution of separate and individual drainage problems. This condition has resulted from several agencies solving different and unrelated aspects of the critical drainage problem. These agencies are:

Santa Clara Valley Water Conservation Districts.

Soil Conservation Service, U. S. Dept. of Agriculture.

Production and Marketing Administration, U. S. Dept. of Agriculture.

County of Santa Clara Engineering, Agricultural and Planning Departments.

Cities of Santa Clara County, and Individuals.

No valley wide drainage study has been made, prior to 1952, for North Santa Clara Valley.[8] The 1944 program of flood control recommended by the Army Engineers for South Santa Clara Valley was considered too costly for the benefits to be gained.

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[8] Report of Water Resources Board. Supplement No. 2, Section No. 1.

Conservation vs. Flood Control

Conservationists are primarily concerned with the impounding of surface runoff waters for future percolation to the underground water reservoir. For this reason the conservationist wants dams to be always as full as practically possible. (Note: Even though Santa Clara Valley's conservation dams are emptied as fast as possible for percolation, they are not emptied after each rain storm as a flood control dam would be.) A flood control dam needs to be always as nearly empty as is practically possible in order to collect recurring storm runoff waters and to forestall floods on the valley floor.

Conservation of Storm Waters Needed

Any plan for flood control and storm water drainage in Santa Clara Valley should also give consideration to water conservation. However, it has been pointed out by two separate and competent agencies that conservation dams always may not act as flood control dams, and that muddy storm runoff waters could do irreparable harm to percolation ponding areas. In 1949 the Corps of Army Engineers reported on the possibility of combining conservation and flood control features in the Lexington Dam, by stating that "an enlargement of the dam to provide additional storage for flood control would not be economically feasible", and that "an examination of other dam sites would no doubt result in the same conclusion."[9]

Feasibility of Multipurpose Dams

In 1952, in a report to the County,[10] the State Water Resources Board stated that "although (the conservation dam) may reduce the frequency of flood occurrence, it also creates a false sense of security conducive to encroachment on flood plains with resultant greater damage during the less frequent occasions of flooding by reservoir spill." Also that "the reservation of primary flood control storage in existing and proposed reservoirs of the Santa Clara Valley Water Conservation District would not be practicable or economical in this area where the conservation of the water supply constitutes the most critical problem."

Only a certain amount of water can be percolated into the ground in any one season due to the limited areas suitable for percolation ponding. As a result of this, it may not be economically feasible nor possible from a practical aspect to store all storm runoff from the mountains for conservation purposes. In addition every effort will have to be made to develop and utilize land suitable for percolation ponding in order to be able to increase the storage capacity for water conservation. Therefore, in the Santa Clara Valley Water Conservation District there may always be the potential danger of storm water runoff and flooding from reservoir overspill.

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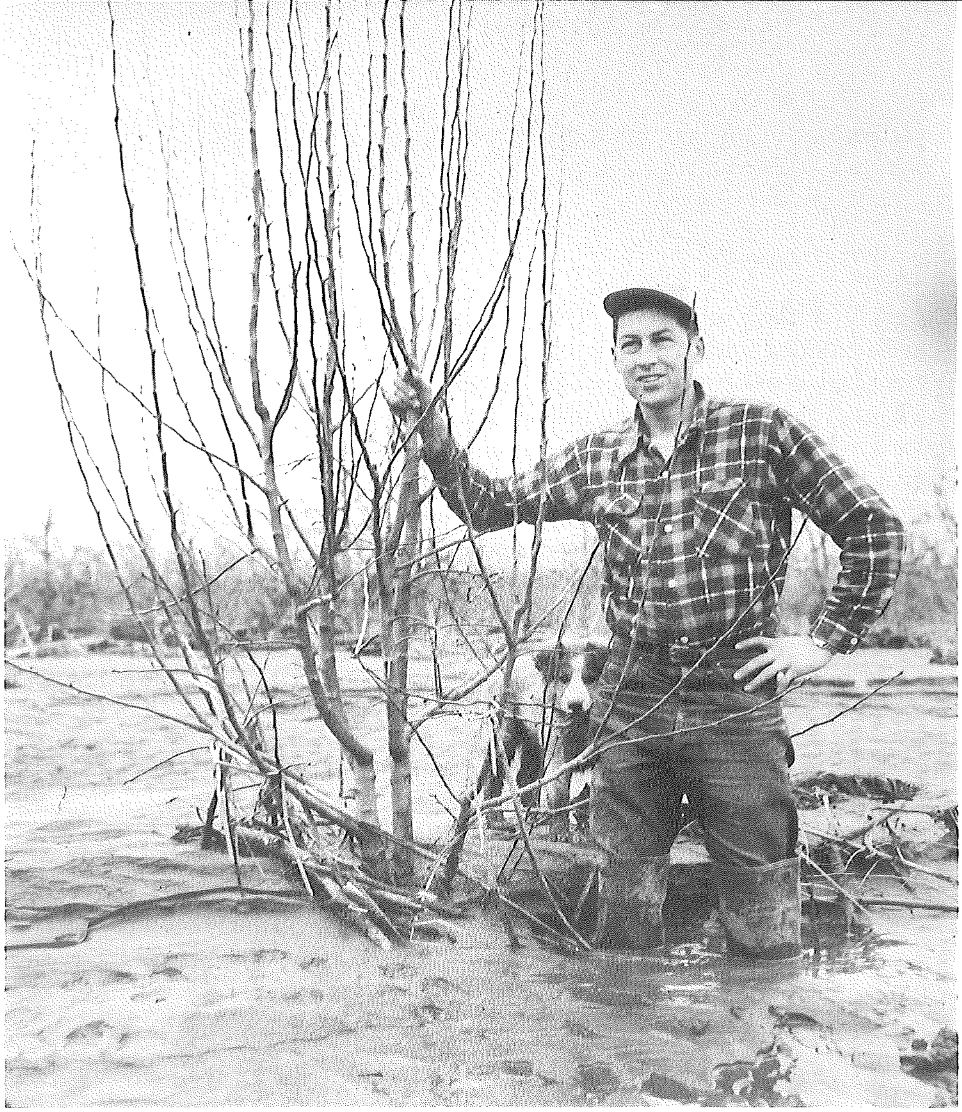
[9] Mark Thomas in a letter to the Planning Commission, June 6, 1949. See Supplement No. 2, Section 7.

[10] Supplement No. 2, Section 1.



John Chinchen

River

Overflow from Guadalupe Creek into Sweetbriar Orchard. Sand, gravel, driftwood caused thousands of dollars damage in this orchard, uprooted 50 trees.

The Problem

Historical Background

Before the settling of the valley, rivers and creeks were free to cut natural channels and make alluvial deposits of rich upland soils over the valley basin clays. At the lower end of the valley near the Pajaro River, on lands adjacent to the San Francisco Bay and in enclosed areas elsewhere, there were large acreages of swamps and wet meadow lands. Much of this land was valuable for grazing but unfit for cultivation of living areas. During the winter runoff these swamp and wet meadow lands became holding reservoirs for flood waters until they could find their way to. the Bay or the Pajaro River, performing the same function as presently constructed retention basins.

Swamps as Part of Drainage Control

Drainage Problem Man-created

The early settlers who proceeded to develop and exploit the Valley upset nature's balance without regard for the inevitable consequences of the flood control and erosion aspects. Careless cultivation caused excessive erosion which in turn filled the swamps so that they became valuable agricultural lands. Even in those early days, some drainage ditches were dug and the natural drainage channels kept open. Irrigation was extended throughout the Valley by pumping from the underground water table. The drainage problem was automatically suspended but not solved when the pumping draft exceeded the natural ground-water replenishment, causing the water table to recede.

Drainage Problem Forgotten

During this dry period drains fell into disuse and natural channels were filled up, cultivated, or planted to orchards. The change-over in land use from agriculture to urban together with the development of former flood plains for orchard and urban use has caused an aggravation of the drainage problem with the return of years of normal rainfall. Much expensive development and land subdivision was based upon a false sense of security regarding the storm water drainage situation. During all dry periods a general and false impression prevails that our drainage problems have been solved.

Hydrographical Factors

Two Factors

In order to provide an adequate solution to the drainage problem two factors must be considered. The first, hydrographical, deals with the source of runoff water. The second, physical, deals with the systems provided by nature and man for the disposal of the runoff waters. This section will be devoted to hydrographical factors of the drainage problem.

Drainage Area

The first hydrographical factor to be considered is the determination of the quantity of storm runoff. The drainage area or watershed must be measured and the amount of runoff waters determined. As mentioned previously in this report the drainage area can be broken down into two sections. One is the hill area wherein it is possible to collect storm runoff waters and percolate them to the underground water table. And the other is the valley plain where because of soil and topographic conditions it is very difficult, if not impossible, to collect and percolate storm runoff waters. The Army Engineers have determined the drainage area for the following rivers and creeks. See table 1, page 17.

	main creeks	drainage area sq. miles	tributary creeks
north valley*	Coyote	394	Canade de Los Osos Los Animas Penitencia San Felipe Silver
	Guadalupe	219	Alimitos Los Gatos Saratoga
	Matadero	16	
	Francisquito	39	
south valley: pajaro river	Llagas	100	
	Carnadero	89	Uvas, Little Uvas Little Arthur, Bodfish
	Tequisquita Slough	278	Pacheco Santa Ana#
pajaro (near Sargent)	Llagas Carnadero Pacheco	490	

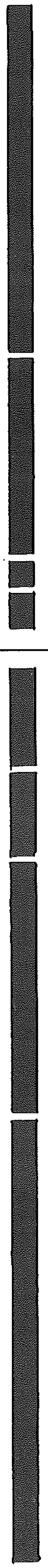


Table 1 Drainage Basins

Santa Clara Valley

Source: Unpublished data, Army Engineers.

*data for Adobe, Permanente, and Stevens Creek had not been determined at the time this survey was dropped by the Army Engineers.

#124 miles of the Santa Ana and its tributaries lie within San Benito County.

Matadero Creek 1
Coyote Creek and Guadalupe River 2
Pajaro River 3
Uvas, Llagas, and Carnadero Creeks 4

1	2	3	4	
			■	1852
			■	1862
			■	1890
■				1894
■				1895
■				1897
■				1900
	■			1907
■		■	■	1908-09
			■	1909-10
■	■	■		1910-11
		■	■	1913-14
	■			1914-15
■	■		■	1915-16
■	■	■	■	1916-17
■				1917-18
■	■			1918-19
■		■		1921-22
■	■			1929-30
	■	■		1930-31
■	■	■	■	1936-37
	■	■	■	1937-38
■			■	1939-40
■		■	■	1940-41
	■			1943
	■			1945
	■			1951
■	■	■	■	1951-52

Table 2 Flood Frequency

Santa Clara Valley

Source: Unpublished data on Santa Clara Valley and published data on the Pajaro River by the Army Engineers, 1944. Wet cycles (known and possible floods) are shown in black.

Inundation Frequency

A second hydrographical factor concerns the frequency and amount of storm runoff waters. The following tabulation gives the information concerning flooding frequency. Tables 2 and 3, pages 18 and 21, represent a compilation of unpublished data which has been collected by the Army Engineers. In order to determine the frequency and volume of storm runoff in its relation to flooding, tables 2and 3 should be expanded to include all drainage areas. A separate calculation should be made for drainage water sheds in the valley floor. This latter calculation will be needed where conservation works are to be installed in the headwaters of drainage channels. It will be necessary to obtain separate data for each drainage area on the valley floor in order to compute the runoff originating in the urban and agricultural areas. This will require a topographical survey of the county. In spite of land subsidence in North Santa Clara Valley, a topographical survey can be kept up-to-date by using the grid developed by the U. S. Coast and Geodetic Survey Land Subsidence. After each re-check by the Geodetic Survey subsidence contours can be drawn. The change in elevation can be determined from these contours.

Each year recorded in Table 2 as a possible flood year has been checked against the monthly rainfall pattern as well as the runoff per second figures of Table 3. The highest cubic foot per second runoff figures occurred during winters when the soil had been completely saturated. Generally there was a pattern of from two to four months of steady rainfall before the flood producing storm occurred. In a few occasions an exceedingly high peak runoff produced flood conditions without any rain in the preceding months. However, with each conservation dam completed the danger from early season flash flood is reduced.

In the future the greatest danger from flooding will be from one or a combination of the following hydrographical conditions.

> Overspill of conservation reservoirs in exceedingly wet winters.
>
> Saturation of the soil by continuous rainfall followed by a flood producing storm.
>
> Flash floods in highly urbanized areas which overload the storm drainage systems.
>
> In the tidal areas high runoff of surface waters combined with high Bay tides.

Flood Frequency

An examination of Table 2 reveals that since 1921 the county has gone through cycles of dry and wet years. Experiences of flood conditions in the wet cycle are generally forgotten during the *next period* of dry winters. Therefore this recurring wet season, in something like a twenty year cycle, is most important to remember. It is because past experience with flood conditions had been forgotten that 1940-1952 urban and industrial developments in some instances were located on poorly drained areas. The flood damage to urban areas during the winter of 1951-52 revealed this lack of foresight or hindsight.

Storm Flow

The design of drainage structures is another hydrographical factor which enters into the storm drainage problem. Such structures are generally treated as clear-water, uniform flow, fixed-stage flow structures. None of these conceptions is true. Storm flows are never clear-water flows; they carry wash silts, suspended silts, bed-load and floating trash. Natural streams, culverts, channel changes and storm drains are seldom, if ever, uniform flow; they are non-uniform flow with velocities changing with each increment of length. Storm water runoff is never a fixed, design stage of flow. Its flow is a variable stage flow beginning at zero rate and increasing to peak rate and trailing back to zero rate again for each and every storm large enough to produce a runoff.

Design of Drainage Structures

This means that the design of drainage structures is still in the formative stages. Until the variables in the mechanics and mathematics of silt, trash, and bed-load transportation are more perfectly appraised, the clear water analysis must be used for design purposes. This approach will increase the potential of flooding when culverts and drainage channels are used to carry storm waters through urban areas.[11]

Physical Factors

Two major conditions in relation to the physical factors of storm drainage which cause land inundation in Santa Clara County are:

Tidal flooding, and
Flooding from storm and surface runoff waters.

The fundamental cause of unfavorable drainage conditions is related to the geological structure of the valley. The geological history, underground water table, land subsidence, soil structure, interior drainage and surface drainage of the soil are all inter-related.[12]

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[11] Based on a report to the Los Angeles County Planning Commission by Charles H. Parker, C. E., Granada Hills, California.

[12] See Part 2 of this report for coverage of these aspects.

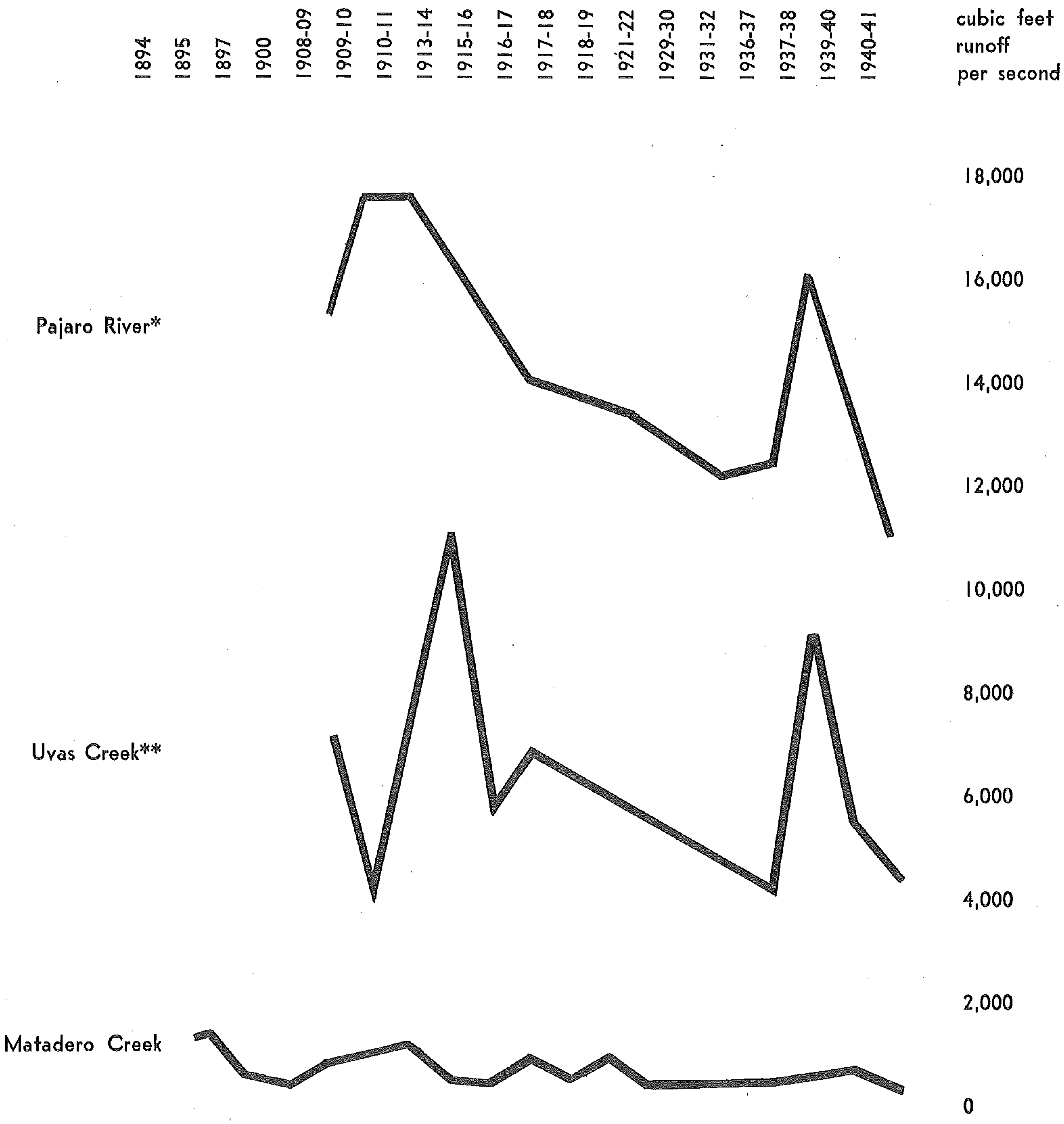


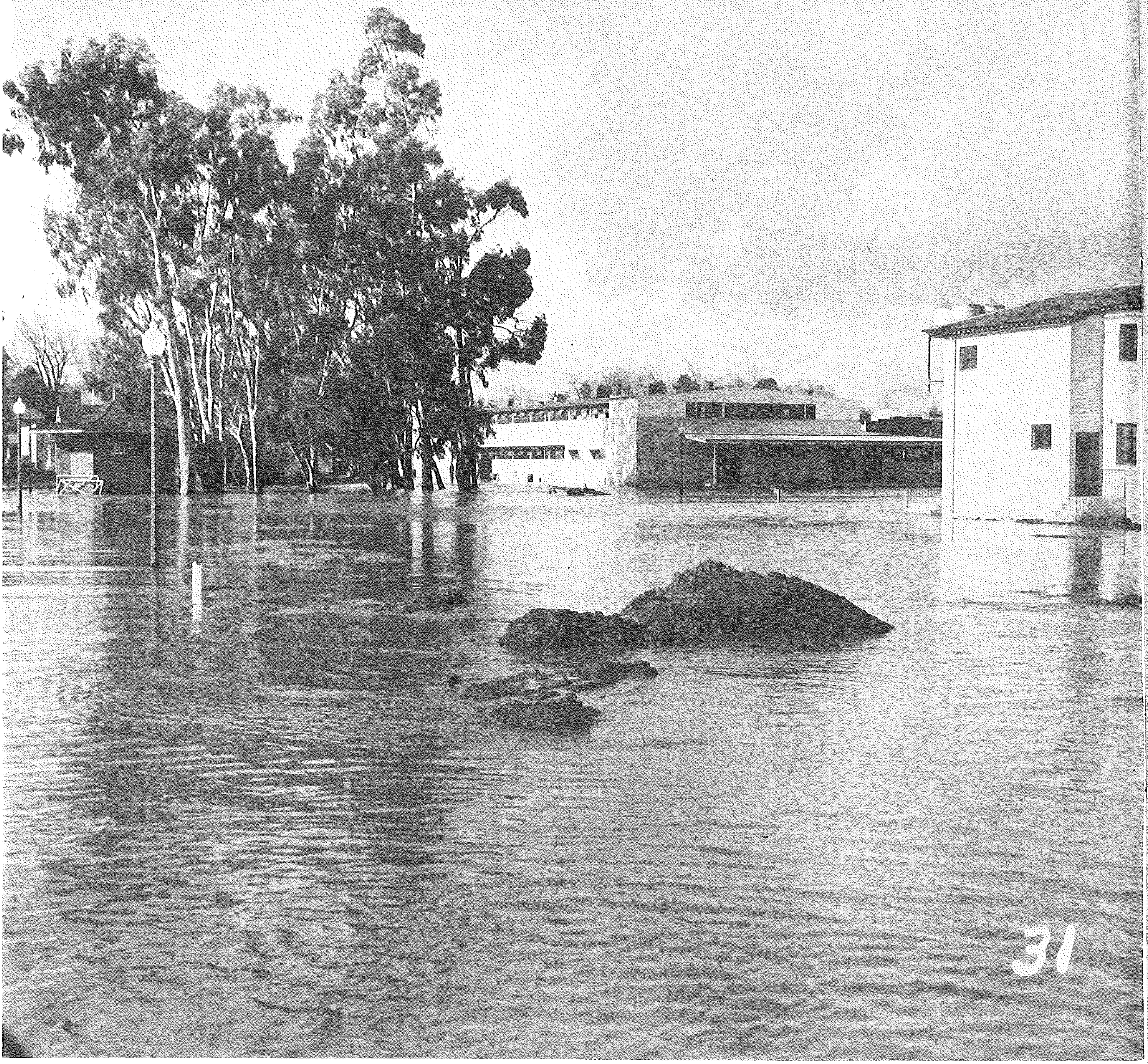
Table 3 Years of Peak Runoff

Santa Clara Valley

Source: Unpublished data, Army Engineers.

*Data collected at the guaging station near Chittenden, 1907-41.

**Data collected at the guaging station near Morgan Hill, 1908-41.



Agnews State Hospital grounds, January 12, 1952. Approximately $200,000.00 in direct and incidental damage was caused to Agnew's properties during the flood. Total loss of valuable winter crop ($35,000.00); levees, drainage ditches, new roads and interior damage to buildings bore heaviest toll. Straightening of Guadalupe River channel, and widening of drainage ditches in eastern portion of grounds is now under way.

Tidal Flooding

During the past thirty years the valley floor has settled from approximately three feet at Alviso to something over six and one-half feet in San Jose. The settling at Alviso and other points along the San Francisco Bay has allowed a greater influx of salt water into valuable agriculture lands than ever before. In addition, actual and potential danger from tidal flooding was increased during the last thirty years. Alviso and many other points would be flooded many times a year by the high tides of the bay if it were not for existing tidal gates and dams.

Tidal Dams

The Leslie Salt Company has diked the major portion of the lands adjacent to the bay for their salt pond operations. The cities of Palo Alto and Alviso have also constructed tidal dikes which are an extension of those of the Leslie Salt Company. This leaves only six restricted points of access to the bay for storm and surface drainage channels. Several of these points of access are controlled by tidal gates.

Agricultural Dikes

Agriculturalists in the Alviso district have built dikes around crop and orchard operations in order to prevent periodic tidal flooding. Because the land subsidence allows greater salt infiltration into rich agriculture soils, agricultural operations of a crop and orchard nature could not be conducted in much of this area without the protection offered by the tidal dikes and gate.

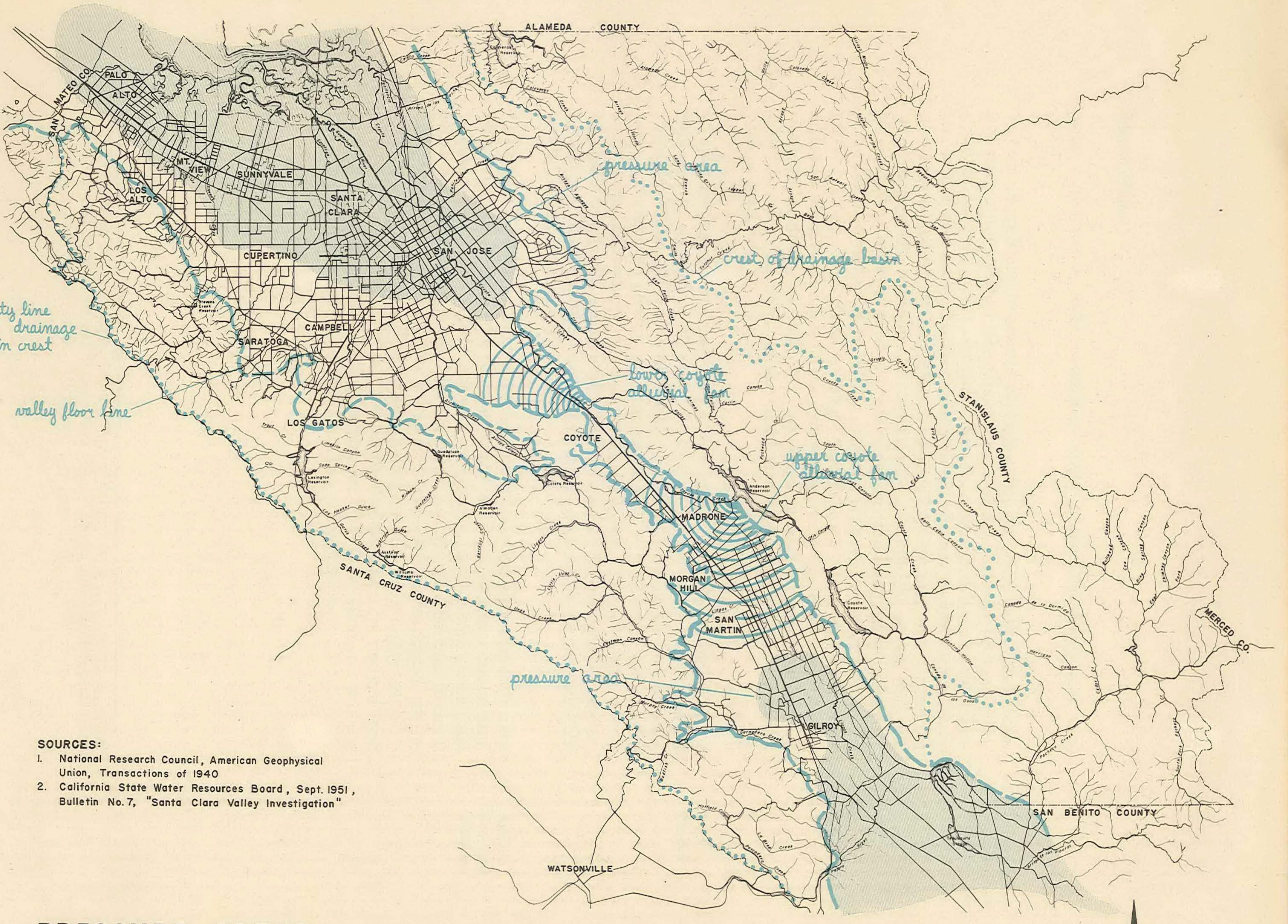
Tidal Dikes Create a Critical Storm Runoff Problem

While all these dikes give protection from tidal flooding, in a reverse manner these same dikes cause greater ponding of surface runoff waters on the flat valley plain adjacent to the San Francisco Bay. Thus, diking which prevents tidal flooding makes inundation of valuable land a critical problem. This ponding also makes it harder to dispose of storm runoff waters once they reach the flat plain adjacent to the bay. (Note: The county should be concerned only with the expenditure of monies to control the storm runoff problem. Protection from tidal flooding is a local problem for the agriculturalist and industrialist. It is very questionable if living areas should be in the tidal plain, especially when this seems to be required for storm runoff holding ponds.)

Flooding From Storm Runoff

Storm waters which reach the main part of the valley floor must be disposed of in the San Francisco Bay or the Pajaro River. Practically no storm runoff waters penetrate directly to the undergound water reservoir after they enter the main valley floor. The geological reason for this is that the main valley floor is composed of very deep deposits of alternating clay and gravel, laid down partially under water and partially through alluvial deposits of silt laden streams. Clay predominates in the lower part of the valley. Near the rim of the valley floor the water is free to penetrate into the gravel formations which dip under the impervious blue clay formations. These blue clays are approximately 300 feet below the surface and produce the pressure areas shown in the "Pressure Areas" plate facing page 24. Replenishment of the underground water table comes from surface or stream bed percolation of runoff from the hills surrounding the valley. The storm waters originating on the valley floor cannot percolate to the underground water table.

Pressure Areas



SOURCES:

1. National Research Council, American Geophysical Union, Transactions of 1940
2. California State Water Resources Board, Sept. 1951, Bulletin No. 7, "Santa Clara Valley Investigation"

PRESSURE AREAS

SANTA CLARA COUNTY PLANNING COMMISSION

11-52

Inundation

Land inundation by surface runoff is caused by the following general conditions:

Channel Beds Higher Than Adjacent Lands

Stream channels and river beds are higher than the surrounding land. Thus, it is almost impossible to take care of local drainage problems between major drainage channels. Long channels must be constructed because the elevation of the river beds prevents drainage by the shortest route. Natural drainage channels are higher than the surrounding land because, over a period of years, deposits of sediment and alluvial silt have built the stream beds and their adjacent banks to present levels while the land lying between drainage channels has remained at its original elevation. Before the valley was settled and the streams and natural drainage channels fixed in their present courses, streams cut new channels in the low swales. It is this process of shifting drainage channels from high to low spots and the deposit of alluvial materials which has built up the valley floor with deep alluvial soils to its present level.[14]

Natural Process

It must be remembered that before man interfered with natural drainage processes in the valley, all these creeks occasionally abandoned their old channels and sought new outlets in the low-lands between the delta formations. Urbanization prevents this natural process. A wise policy would be to study ways and means by which ultimate changing of channels already built up above the general valley level could be adjusted to the needs of present agricultural development. However, in urban areas, drainage channels cannot be shifted about at will.

Altered Drainage Channels

Drainage channels have been altered. In some instances agriculturalists have obliterated all traces of the drainage channels. In other instances, natural drainage channels have been altered by re-routing them around agricultural areas and subdivisions so that there is either not enough difference in elevation to keep the channels free from silt or enough flow to remove the required amount of water. The flooded conditions during the winter of 1951-1952 in the Foxworthy Avenue and South Willow Glen area resulted from a natural drainage channel being shifted out of Willow Glen and made to run along the higher ground parallel to Foxworthy Avenue.

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[14] This process has been explained in greater detail in Part 2 in the sections entitled Geological Background and Interior Drainage, pages 56, 70. The alluvial deposits in the central portion of the valley floor vary from 1,000 to 4,000 feet.

Tidal Dams Block Creeks

Dams at the tidal flats have obstructed major drainage channels so that today many such channels have no direct access to the bay. The Permanente, Adobe, Dry and Stevens Creeks are without direct access to the Bay. Every winter a certain amount of ponding results from these man made obstructions. Flooding reached critical proportions during the winter of 1951-1952 near the San Francisco Bay because of this condition.

Silting

The silting up of drainage channels near the San Francisco Bay is a problem which must be solved if proper disposal of surface runoff waters is to be achieved.

Roads Are Inverted Dams

Inverted dams are formed by roads due to the compacting of the soil. These inverted dams then act to restrict subsurface drainage and in some instances cause the land to become waterlogged. This in turn causes greater runoff of surface waters because the soil has lost its normal absorption characteristics. Such roads as Stevens Creek, El Camino Real, the Bayshore, Monterey, and Coffin are good examples of such inverted dams. The railroads also form the same kind of an obstruction to surface and subsurface flow of water.

Subsoil Saturation

Saturation of the subsoil, generally confined to the tight nonpermeable clays or silty clays, is caused by seepage from higher to lower elevations, former swamp areas and the inverted dams created by roads.[15]

Alluvial Dams

An alluvial dam, for both surface and subsurface water flow, stops seepage along an impervious pan. The stoppage of this subsurface seepage causing saturation of the subsoil and the alteration of drainage channels are the factors which have contributed to the critical drainage conditions in the Alum Rock-Evergreen area.

Subdivisions Increase Runoff

Because it removes more than half the area available for percolation of the rain water and because it has more paved surface than farm land, subdivided land contributes to surface runoff. Storm water flows faster, and the increase in volume and velocity of storm runoff in turn is creating potential flood conditions over large areas because of lack of adequate drainage channels. Generallythe same land could be properly drained without additional provision for surface drainage if it remained in an agricultural use or all subdivisions were provided with adequate storm sewers. However, the provision of storm sewers in subdivisions would overtax present drainage channels. This condition was one of the principal physical factors which caused flooding in the Mountain View, Palo Alto, Campbell and San Tomas districts during the winter of 1951-1952.

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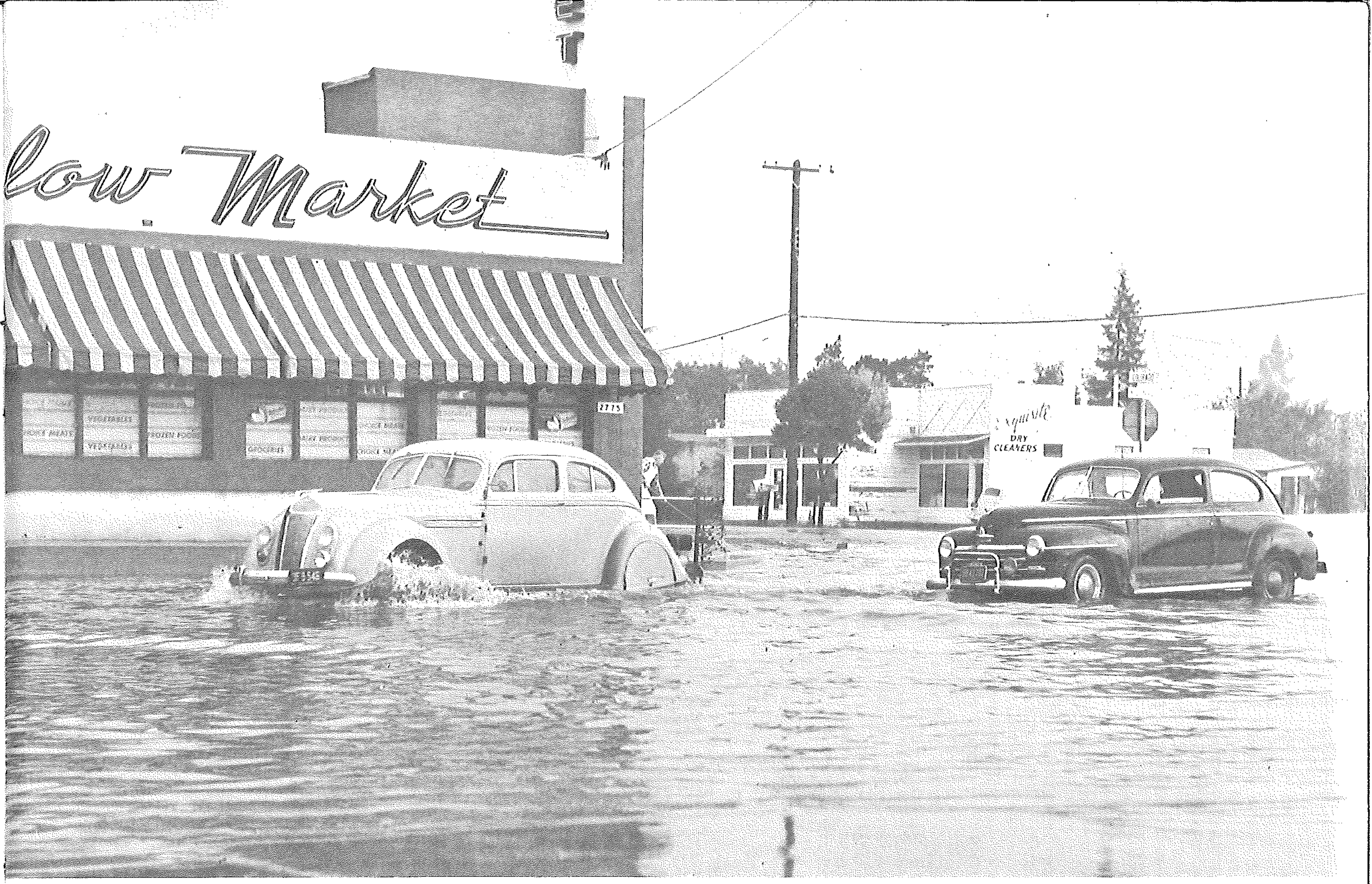
[15] Data furnished by County Surveyor, U. S. Dept. of Agriculture, Bureau of Production and Marketing Administration, and U. S. Soil Conservation Service, The Agriculture Extension Service.



Middlefield Road and Colorado Avenue, Palo Alto, January 1952.

Conclusion

Surface runoff, tidal flooding, high ground water tables, the clay soil, sinking of the valley floor and blocking of natural drainage channels by the salt company operations are all contributing physical factors to the present dangerous flood conditions. Many more potential flood areas are being created. To properly service agricultural areas now being developed as residential subdivisions, an adequate program of local and major county storm sewers would have to be established.

Flood Areas: North Valley

Tidal Flats and Adjacent Area

Adverse conditions in this area include waterlogging of agricultural lands from high ground water and flooding of these and other lands by overflow of the streams during heavy winter storms. This district covers about 27,000 acres lying north of San Jose and roughly includes the area between the Southern Pacific Railroad Line to Niles and Palo Alto and extends from the Bayshore Highway to tidewater. This area, practically coincident with the waterlogged lands and the artesian belt, has sunk from three to five feet from the elevations recorded in 1912. High tide now comes:[16]

High Tide

1. On the Guadalupe River to Montague Road near the community of Agnew.[17]
2. On the Coyote River to within one-quarter of a mile south of the Alviso-Milpitas Road.
3. On Permanente Creek to within one-quarter mile of Charleston Road.
4. The elevation of mean high tide is 6.5. Such a tide would overflow the present Bayshore Highway between Palo Alto and Mountain View.

Blocked Channels

Tidal dams, flood control surge ponds and dams, and the salt company dams and evaporation ponds block the folloing major creeks: Adobe, Dry, Matadero and San Francisquito creeks near Palo Alto; Permanente and Stevens Creeks near Mountain View; and the lower Calabassas and Saratoga creeks near Alviso. None of these creeks have direct access to the Bay. This lack of an outlet to the Bay causes flooding of lands between the Bayshore Highway and the Bay. However, if the tidal dikes and salt company dikes were removed, this same land area would be flooded several times a year with each high tide. In fact, around Palo Alto and Mountain View the Bayshore Highway would be acting as a tidal dam to keep the Bay waters from flooding farther inland. The Bay waters would reach a point near Agnew without these existing tidal dikes and dams.

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[16] U. S. Dept. of Agriculture, Production and Marketing Administration.

[17] Photographs by Par Photo Service, San Jose and aerials by the U. S. Navy, Moffet Field, 1952, are a graphic record of flooding in this area.

area		
Alviso, Agnew	$264,568.00	creek overflow damage
San Jose, Berryessa	$3,000.00	
Alum Rock, Evergreen	$39,940.00	
Los Gatos, Campbell	$14,070.00	
*Moffett Field	$1,956.00	
Sunnyvale, Santa Clara	$48,952.00	
Mountain View	$20,850.00	
*Palo Alto	$	
	$393,836.00	total
Stanford	$915.00	general runoff damage
Mountain View	$200.00	
Monte Vista	$18,500.00	
Los Gatos	$12,700.00	
	$32,315.00	total
	$426,151.00	total flood damage**

Table 4 Flood Damage 1951-52
Santa Clara County

*one life lost.

**an additional $89,004.84 has been filed against the County of Santa Clara in flood damage claims, 1/10th of which was damage allegedly caused by cloud seeding activities.

Alviso's Tidal Dikes

In this area these dams restrict the flow of all minor and major natural drainage channels at their termination into the bay. Alviso's tidal dikes restrict to some extent the flow of the Guadalupe River. These are the very points where the flow of surface water either should be unrestricted in order to avoid the backing up of flood waters or the flow should be retained in surge ponds until it can be discharged into the Bay. The land in this area is heavy clay and flat without any appreciable fall into the bay so that the maximum flooding is caused as the result of the backing up of storm water.

Overflow of Channel Banks

During moderate floods the Guadalupe overflows near Brokaw Road and again near Montague Road, running great quantities of water down across the orchards along the San Jose-Alviso Road, and between the road and the creek.[18] In heavy floods this creek is almost lost in the mass of flood water that prevails in the lower section. The overflow of Coyote Creek recently has inundated high value farming lands extending from Wayne Station to the Bay. The Guadalupe River during the winter of 1951-1952 kept lands from Montague Road to the Bay under water for over a month. Near Milpitas, large areas of farm land are inundated practically every winter. Much of this flood water from both creeks stands on the land long enough to do permanent damage. It also augments the ground water and thus aggravates the drainage problem for the next year.

16 Year Trend

Within the past sixteen years (1936-1952) a number of rather destructive floods have occurred in which all the main streams have overflowed their banks. In 1952 considerable damage was done to farm lands and other property (See table 4, page 30). This condition occurred in spite of the fact that conservation reservoirs, which are effective in materially reducing the flood hazard, have been built at the headwaters of most of these streams. However, the very existence of these conservation dams has led to the false assumption that floods were over. Upon examination it is found that the channels of all the creeks in this area have been badly silted up in recent years so that their carrying capacity is greatly reduced toward the lower end of the valley plain.

Major Creeks Without Outlet

The major creeks which are effected are the Guadalupe, Coyote and Saratoga Creek. Other adverse conditions in this area include waterlogging of agricultural lands from high ground water and flooding, seepage of irrigation and ground waters from higher elevations into this waterlogged area, and land subsidence.

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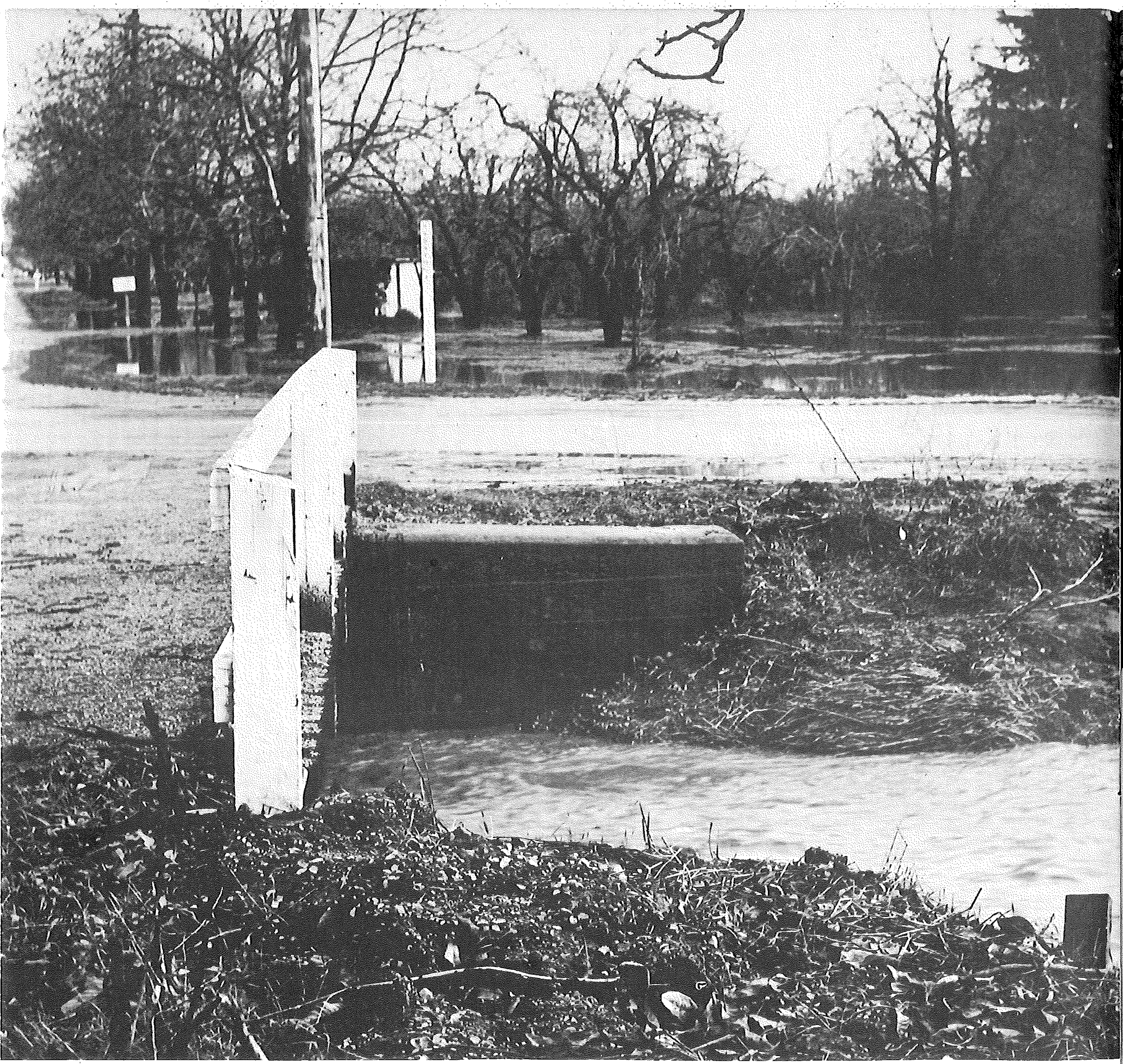
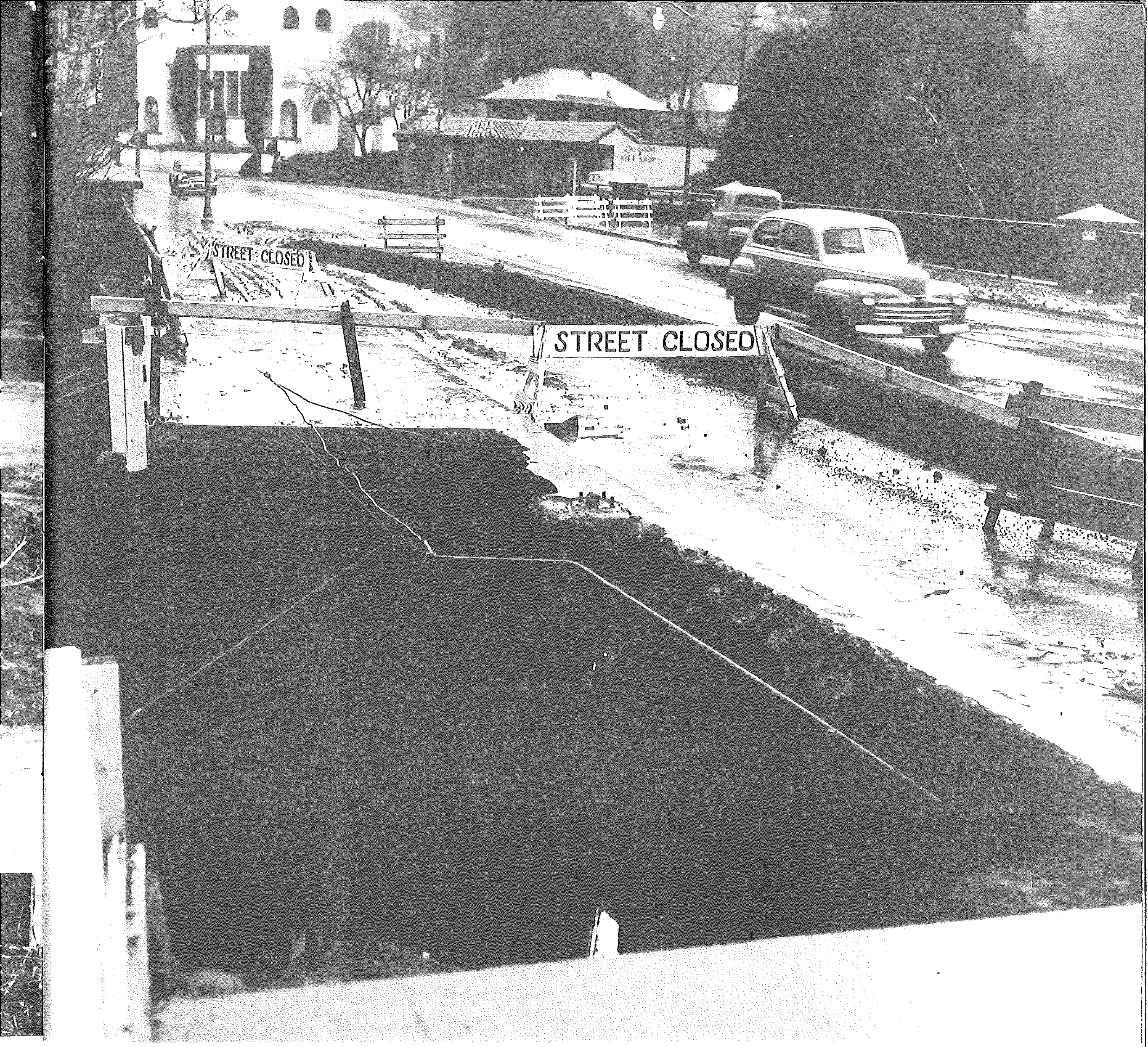
18. See reports by J. Winter Smith; the County Suryeyor; and the U. S. Army Engineers, on the Guadalupe Creek Flood Problems. This material may be found in the files of the County of Santa Clara Planning Commission.



This intersection at Prune and Saratoga Avenues in Santa Clara was one foot under water at the peak of the January 1952 flood.

Portion of San Tomas Aquino Crk
being urbanized



Monday, January 14, 1952. Photo taken on San Jose Aveune in Los Gatos showing big cavity caused by storms in approach to Los Gatos Bridge over Los Gatos Creek.

The Palo Alto, Mountain View, Sunnyvale and Cupertino-Saratoga Areas:

Potential Flood Areas

If not now subject to flooding, land lying between natural drainage channels will be exposed to the potential danger of becoming inundated upon being subdivided. Many orchards which now take care of surface runoff are not suitable for subdivision under present conditions unless adequate drainage channels are provided. The Matadero Creek between the Bay and El Camino Real has in the past overflown its banks.

Matadero Lacks Channel

Land adjacent to the Matadero Creek has been recorded by the Army Engineers as one of the historical flood areas in Santa Clara County, together with the tidal basin and the Campbell, Coyote and Guadalupe Creeks. This is because the Matadero Creek never had a channel below the Southern Pacific Tracks. Water from the creek wandered through a swale. When this area was subdivided a drainage ditch was constructed on high ground to the east of this swale. During the winter of 1951-1952 water was seen being pumped from several houses after the January flood.

A record from 1894 to 1941 has been prepared for an unpublished report on the Matadero Creek by the Army Enginees in 1941. The report stated that any storm causing a peak discharge of over 600 cubic feet per second would produce a flood below Alma Street in Palo Alto. This is because a natural channel for Matadero Creek does not exist between Alma Street and the Bay. Originally, storm runoff waters found their way to the Bay through a natural swale. A drainage channel was dug on higher ground to the east. This channel has a peak capacity of approximately 600 cubic feet per second. (See table 3, page 21.)

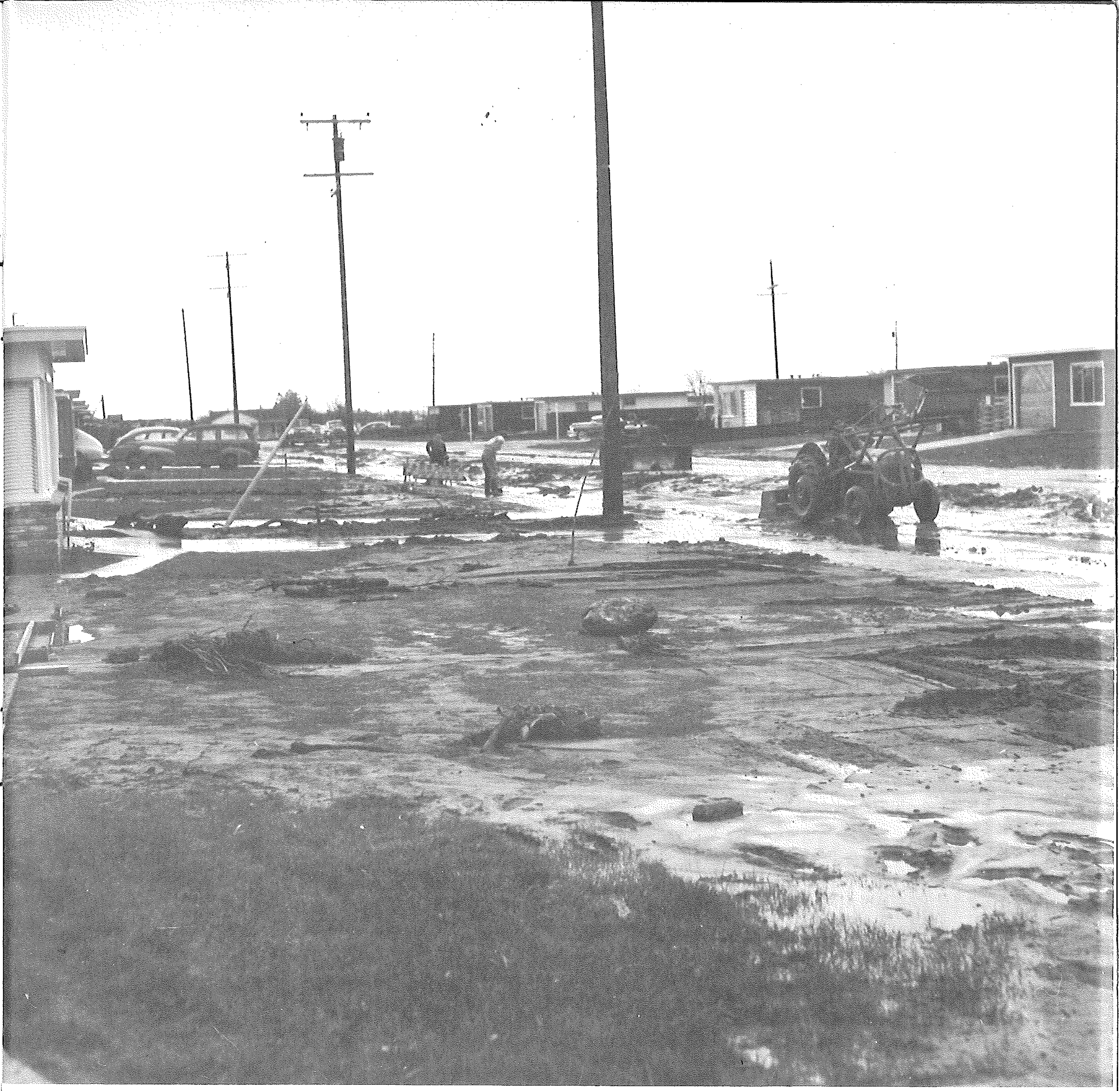
Inadequate Culverts

Blocking of Stevens and Permanente Creeks by culverts under the El Camino, Alma Street and the Southern Pacific have caused recent floods. Blocking of Saratoga and San Tomas Aquino Creek by inadequate culverts under the Bayshore Highway has blocked the natural drainage so that the water may stand four feet or more deep on the southside and be dry on the northside.

The Los Gatos Area

Former Swamp

There are adverse drainage conditions which cause flooding in the area between Los Gatos-Almaden Road and Kennedy Road. This was a former swamp formed by an alluvial dam on clays and silty clay loams. In wet winters quick runoff from the steep hills causes damage to roads and property. During the winter of 1951-1952 Los Gatos twice suffered from flash runoff of storm waters.

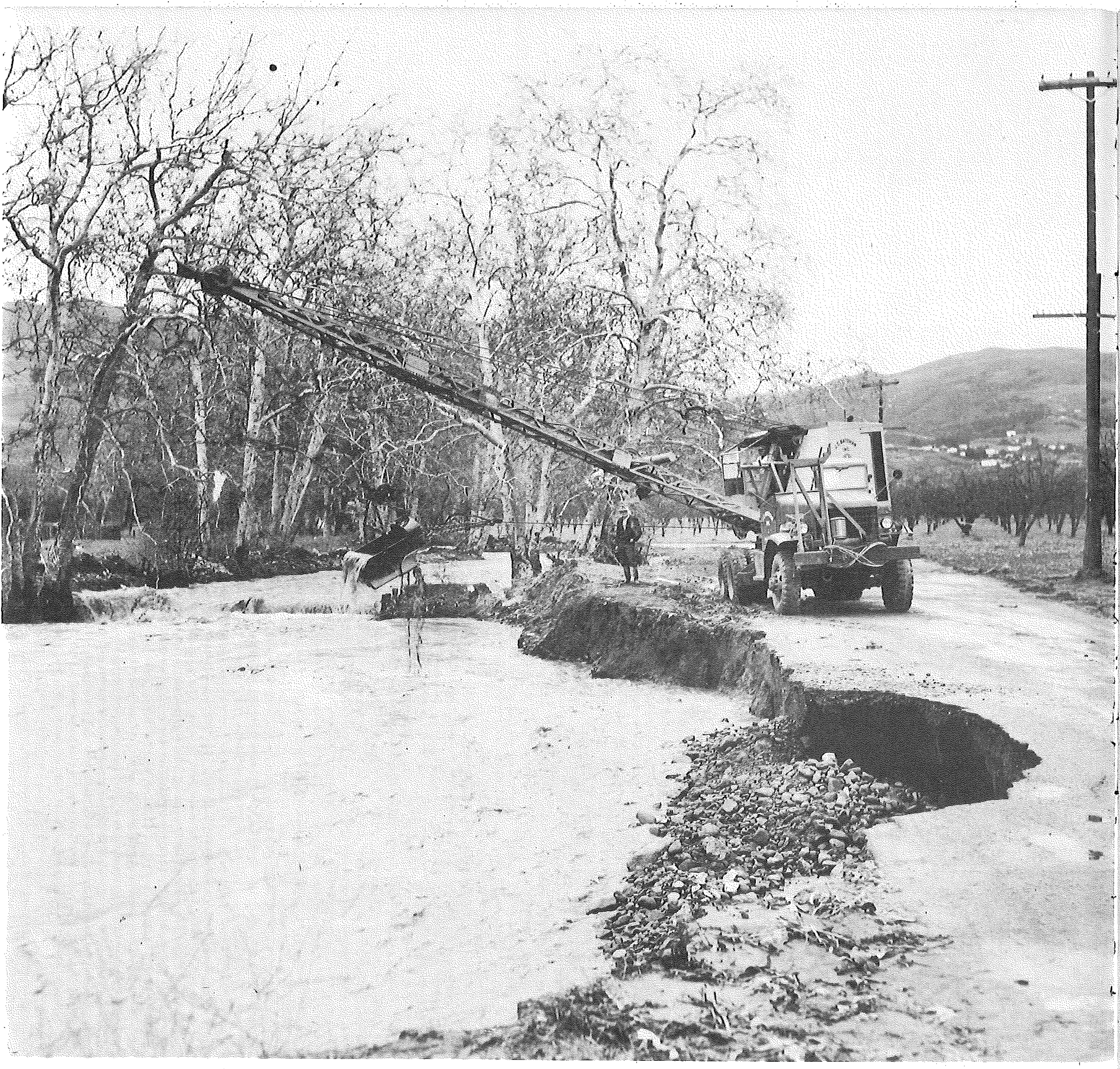


Woodhaven subdivision, East San Jose, Alum Rock district, January 15, 1952.

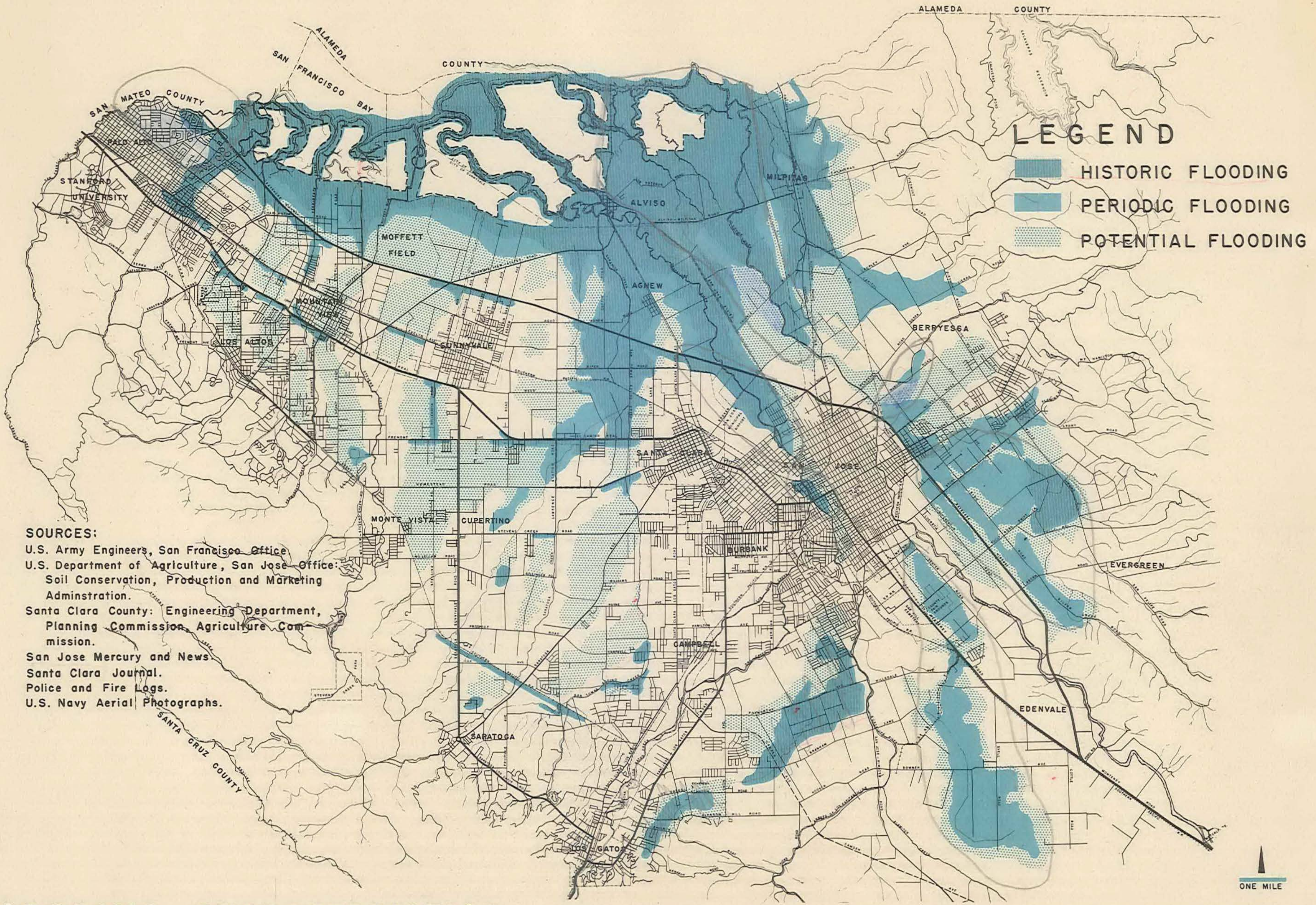
[illegible]

(Now [illegible])

Subdivision houses - some had 6" to 8" mud inside.

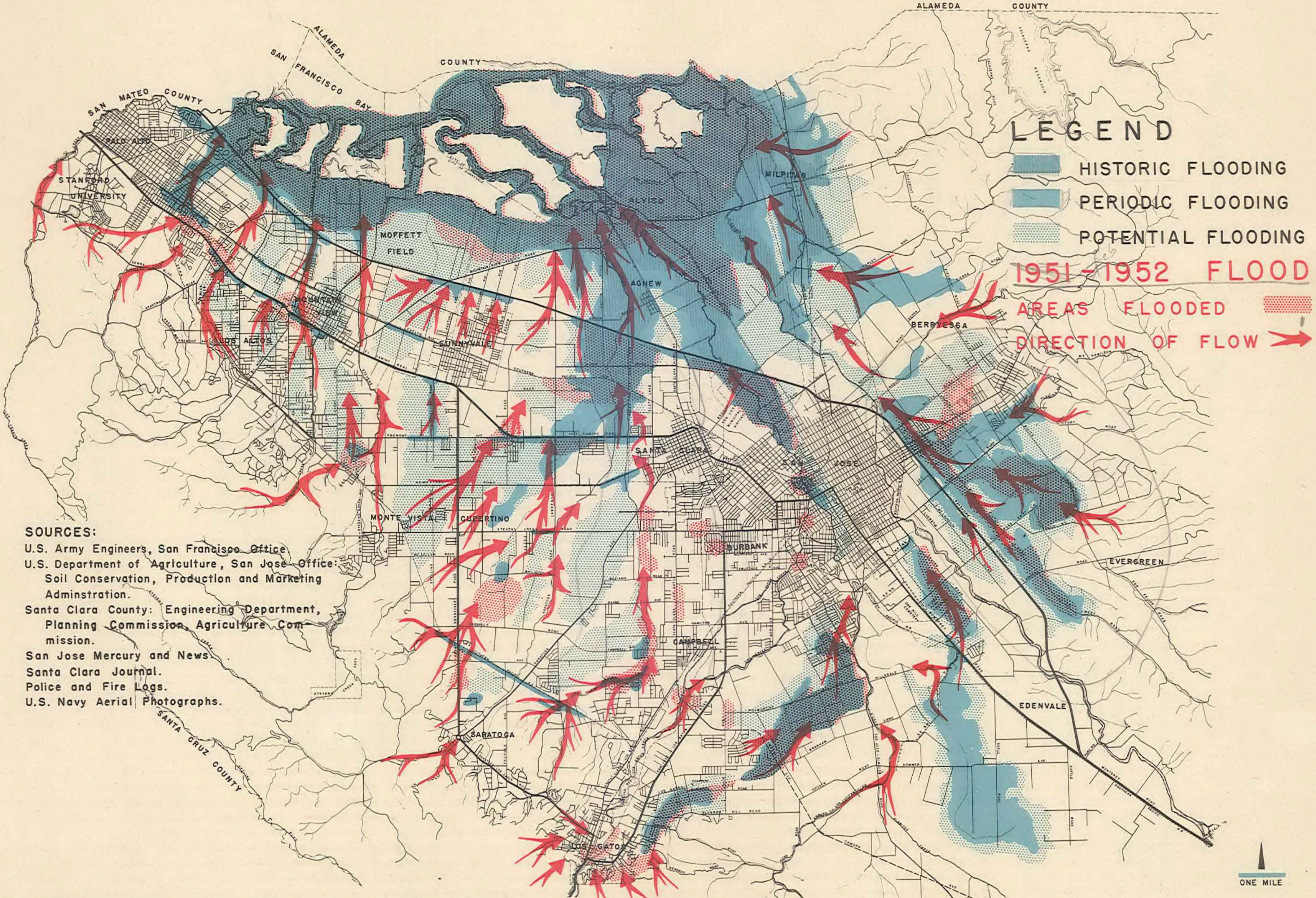


January 15, 1952, Penitencia Creek above Piedmont Road. Portion of the Penitencia Creek Road washed out by Mt. Hamilton runoff.



SOURCES:
U.S. Army Engineers, San Francisco Office.
U.S. Department of Agriculture, San Jose Office: Soil Conservation, Production and Marketing Adminstration.
Santa Clara County: Engineering Department, Planning Commission, Agriculture Commission.
San Jose Mercury and News.
Santa Clara Journal.
Police and Fire Logs.
U.S. Navy Aerial Photographs.

FLOODING CHARACTERISTICS NORTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION



SOURCES:
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U.S. Navy Aerial Photographs.

FLOODING CHARACTERISTICS

NORTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION 11-52

The Downer Avenue Area:

Shallow Rooted Crops

In the Downer Avenue area there is a former swamp which has been also formed by an alluvial fan deposit. Although there now is a drainage channel to the Coyote River, this district is still subject to flooding because of topography and soil conditions. In this area a partial solution to the problem of flooding and a high water table has been found by the introduction of shallow rooted crops. Although relief through local drainage has been furnished to some extent for the district, it still has flood potentials which would make subdivisions very difficult, if not impossible. About 50% subdivided in June, 1970 — mmB

The Evergreen District

Silver Creek

East of San Jose along the Silver Creek is another district which was a former swamp. North of Alum Rock Boulevard the junction of the Silver and Penitencia Creeks formed an alluvial dam which created this swamp condition. Many people could be found in 1952 who remembered hunting ducks here. In wet years this area is still subject to inundation. Located here are the Vollmer and Bennett subdivisions which were flooded in January 1952 as well as during the winters of 1948 and 1951. Seepage from the hills and lack of adequate drainage channels are contributing factors to flood conditions. Drainage conditions in the Evergreen area have been materially improved by the construction of a storm water drain ditch carrying surplus water into the Coyote Creek. While on the other hand the relocation of Silver Creek inland from its former channel near Bayshore Highway has created a large winter seepage area near Tully and White Roads. The crops were destroyed by a lake in this location during the winter of 1951-1952. This district still needs further attention, especially in the newly subdivided areas.

Flood Areas: South Valley

Soap Lake

The South Valley Area covers about 7,000 acres extending south and east from Gilroy to the Pajaro River. Five times between 1937 and 1944 and again in 1952 destructive floods visited this district. In one flood alone (December, 1937) over 5,000 acres of crop land were flooded, with a total damage exceeding $200,000.00.[19] In each flood, thousands of acres have been inundated for a considerable length of time. This greatly restricts the adaptability of these good soils to farming uses for which they would otherwise be most suitable. The flood hazard still continues, and the average annual damage from this source exceeds $20,000.00.

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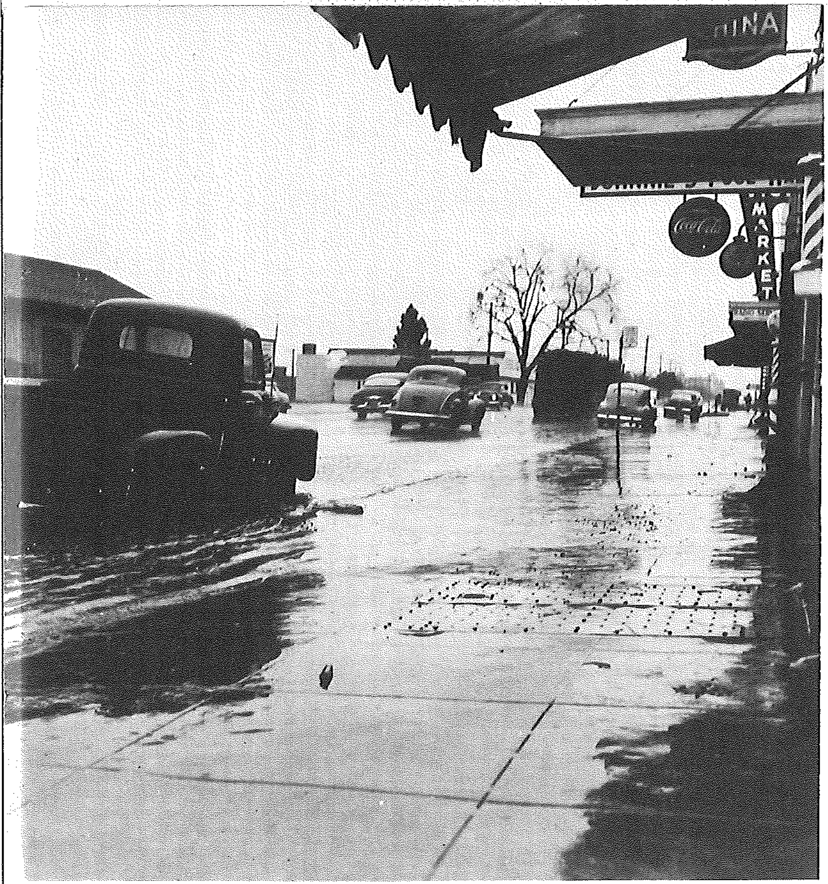
[19] The flood of the winter of 1951-1952 was just as great as that of 1937.



January 1, 1952. Monterey Street, Gilroy, during heavy weekend downpour. No damage was reported in area, although the Carnadero and Pajaro Rivers experienced sharpest rises of season. Flooding of Llagas Creek placed portion of Bloomfield Avenue under water.

Over a considerable portion of this area a high ground water table is indicated by a growth of tules and willows. Impervious subsoil conditions and surface soils with low percolation characteristics cause waterlogging of the lands. This waterlogging tends to create potential flood areas. Much of South Santa Clara Valley was inundated in the winter of 1951-1952; see "1951-1952 Flood, South Valley" plate, page 40a. A number of large and expensive drain ditches have been constructed to relieve this situation, but the problem is still serious.

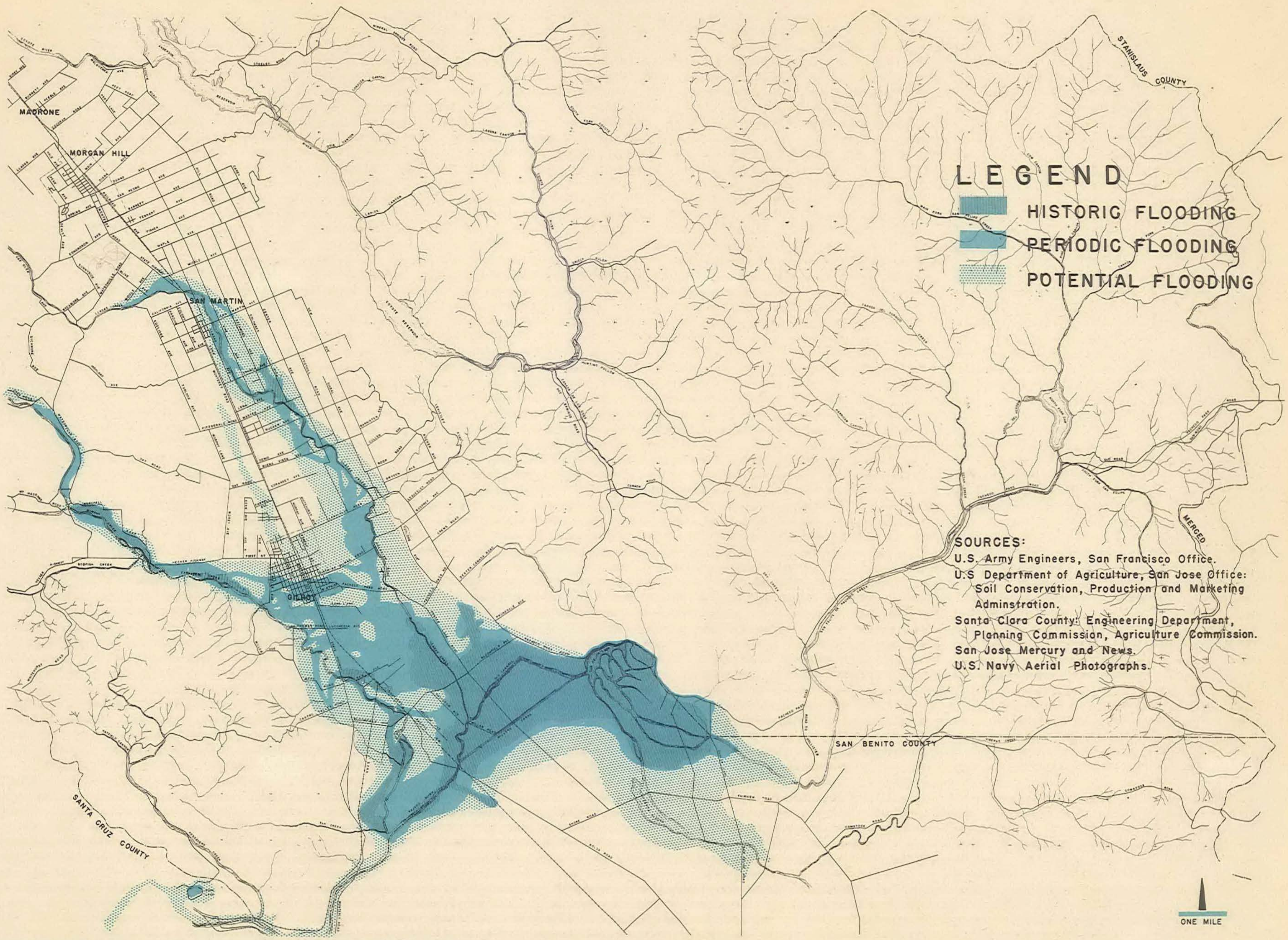
Llagas Creek

Along Llagas Creek, east of Glroy and San Martin, old drainage channels have been obstructed. Flood waters during 1951-1952 were not permitted easy outflow and caused considerable waterlogging of orchard lands. A similar condition existed west of the El Camino Real highway where many acres of orchard lands have been harmed from this cause.

Minor Areas

Laguna Seca

A former swamp condition at Laguna Seca has been partially relieved by an expensive drain ditch which in general works effectively to solve the drainage problem.



LEGEND

- ▆ HISTORIC FLOODING
- ▆ PERIODIC FLOODING
- ▒ POTENTIAL FLOODING

SOURCES:
U.S. Army Engineers, San Francisco Office.
U.S Department of Agriculture, San Jose Office:
  Soil Conservation, Production and Marketing Adminstration.
Santa Clara County: Engineering Department, Planning Commission, Agriculture Commission.
San Jose Mercury and News.
U.S. Navy Aerial Photographs.

FLOODING CHARACTERISTICS SOUTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION 11-52

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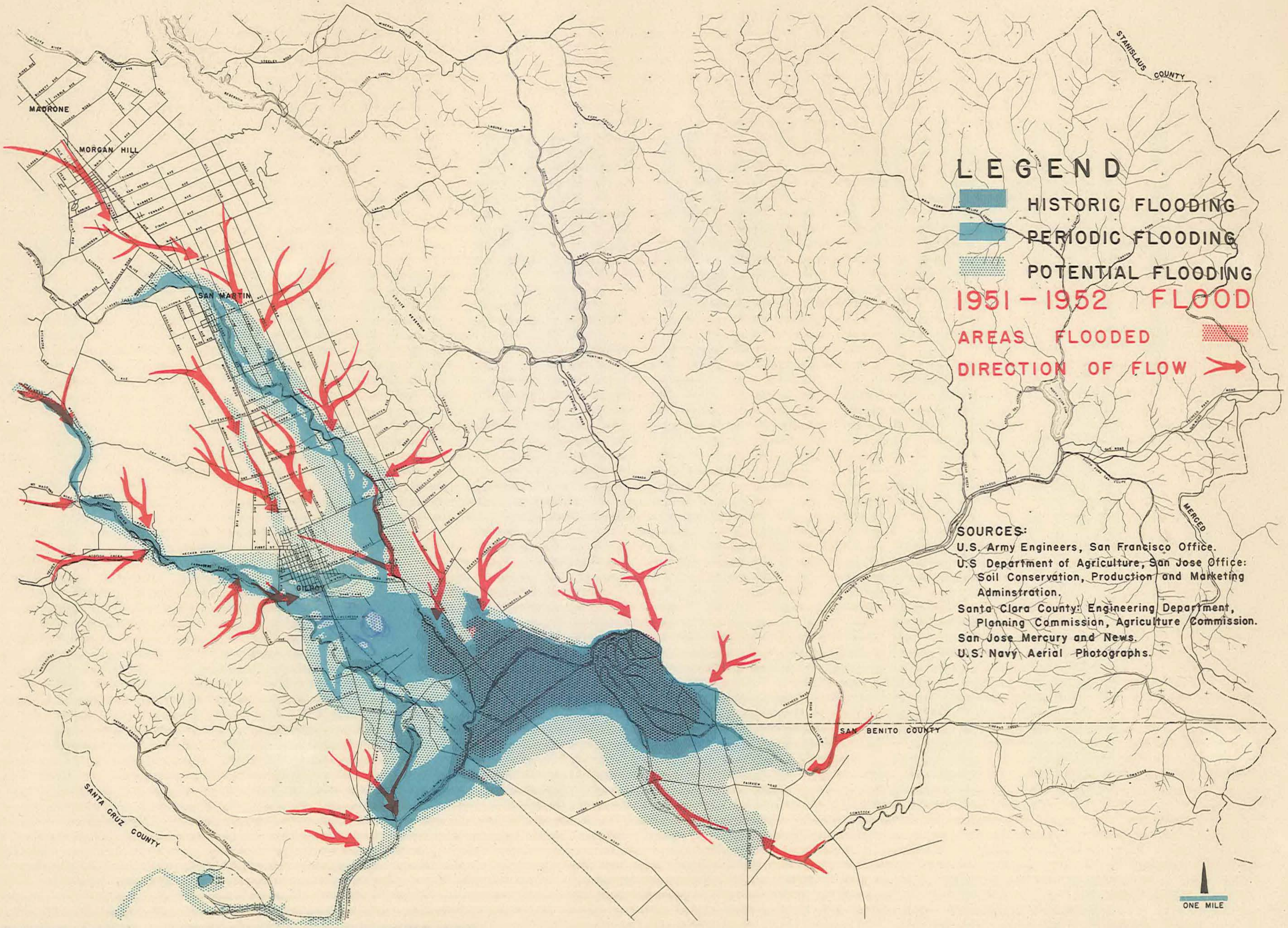

SOURCES:
U.S. Army Engineers, San Francisco Office.
U.S Department of Agriculture, San Jose Office: Soil Conservation, Production and Marketing Adminstration.
Santa Clara County: Engineering Department, Planning Commission, Agriculture Commission.
San Jose Mercury and News.
U.S. Navy Aerial Photographs.

FLOODING CHARACTERISTICS SOUTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION II-52

The Solution: Analysis

Local and Individual Action not a Solution

In the preceding sections the drainage problem has been outlined. An analysis of the action taken in the past reveals that it has been aimed at the local and individual problem. Thus, action taken to correct drainage conditions in one area has caused more complicated and critical drainage problems elsewhere.

An Urban Problem

The drainage problem is of greater prominence and is more critical in nature today because of the urbanization of large areas of the former orchard land. Some of this subdivided land was in the historical flood plain. During the past ten years much ground work has been done in finding a solution to the problem. Also, ideas for solving the drainage problem in urban areas have been proved or disproved by the flood of the winter of 1951-1952.

Hydrographical Factors

With respect to hydrographical factors, it has been proven that floods are of a recurring nature in the valley floor A great deal of the waters originating in the hill areas can be stored and percolated into the underground water table, although all storm waters originating over most of the valley floor and that which cannot be stored in the hills must be disposed of in the San Francisco Bay or the Pajaro River. The disposal of the latter runoff must be by a system of drainage channels and structures.

Drainage Structures

The correlation of drainage structures, storm water runoff and urban development must be considered. For example, a dainage plan developed in Los Angeles County to take care of floods of a 25 and 50 year rainfall frequency was found in 1950 to be only capable of taking care of floods on a two year rainfall frequency. The winter of 1951-1952 really overtaxed this system. The Los Angeles County experience points out that their drainage system was underdesigned because of two misconceptions.[20]

1. "Advancement in the sciences of hydrology and hydraulics shows that engineering text book and handbook data are inadequate and often erroneous when applied to drainage structures."
2. "The speed, magnitude, character, and pattern of property developments were incorrectly appraised, and the hydrologic and hydraulic effects of these changes in land use were unforeseen."

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[20] Unpublished 1950 report of Charles H. Parker to the Los Angeles County Planning Commission.

The experience of the Los Angeles City Storm Drainage Department is similar to that of Los Angeles County.

Dual Purpose Dams

In the Los Angeles area it was also found that dual purpose dams were not effective as flood control dams.[21]

> "The flood of March 2, 1938 was due to five days of rain ending with unusually high intensity on the last day. Nearly full or full conservation reservoirs were caught with little or no storage capacity available for flood protection. For a built up area like metropolitan Los Angeles the results can hardly be imagined if they have not been experienced."

Comparison

During the winter of 1951-1952 in the Los Angeles area a similar condition existed. Over a period of several weeks the rainfall filled the conservation dams so that they afforded no storage space to the storms that followed. In Santa Clara County during the winter of 1951-1952 a critical flood potential condition existed from the overspill of the existing conservation reservoirs.

Growth in the Valley

Santa Clara County is experiencing a growth pattern similar to Los Angeles County. The trends in growth between 1939 and 1950, and 1950 and 1952 are shown in the "Urban Growth Trends" plate, facing this page. It should be noted that the urban growth of both residential and industrial areas between 1950 and April of 1952 was greater than that experienced between the 1940 to 1950 decade.

Urbanization of Storm Runoff

This tremendous growth in the county, since the last cycle of wet winters in 1937 and 1940, has been one of the contributing factors to the generation of a greater storm water runoff in the valley floor during the winter rains of 1951-1952. Residential areas which discharged storm waters into streets and adjacent orchard lands caused downstream floods in such areas as Foxworthy Avenue, Campbell, Santa Clara and Mountain View.

Agricultural vs. Urban Areas

The most impervious agricultural soil is able to absorb more storm runoff waters than urban areas. Therefoe, it can be seen that the urban area, with its paved streets, impervious yards and roofs, added to the storm runoff. If urbanization of the valley floor continues, a critical flood condition can be created in what are now agricultural districts.

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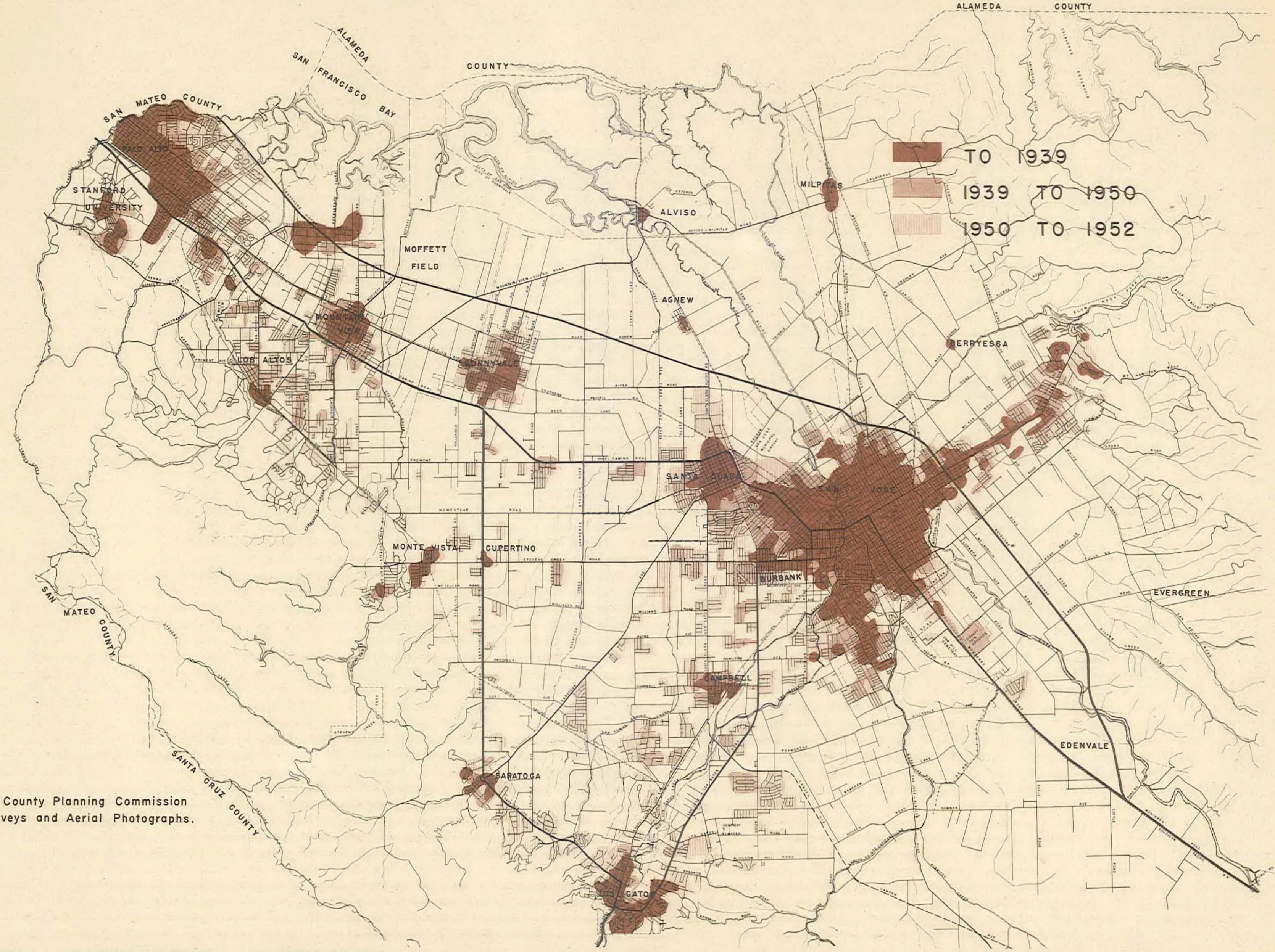
[21] Ibid.



SOURCE:
Santa Clara County Planning Commission
Land Use Surveys and Aerial Photographs.

URBAN GROWTH TRENDS NORTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION

ONE MILE

11-52

Hydrologically the effect of the January 1952 storm proved that:

1. Drainage ditches should be kept open in order to prevent overflow and backing up of flood waters.
2. The design of drainage structures has not yet been correlated to the large increase in subdivisions since 1950, as was shown by the overtaxing of existing drainage structures in the floods of 1951-1952.
3. Storm waters should not be dumped into county roads, as such waters cause damage to the road system and abutting properties.
4. Subdivisions should be provided with a storm sewer system.
5. The county needs to develop an adequate system of storm drains in relation to population growth and the potential runoff of a drainage basin.
6. Such urban growth should be controlled and related to areas in which the county can provide and maintain an adequate storm drain system.
7. Storm damage is costly to county residents as is shown by the totals in table 4, page 30. This tabulation is only partial as all damaged areas had not submitted estimates at time of publication of this report.
8. A critical storm drainage problem exists in the county, especially in the residential developments.

The inadequacy of upstream interception and downstream disposal capacities of the Santa Clara County existing drainage system creates a critical problem which will be costly to solve.

Corrective Measures

North Valley Area Tidal Flat and Adjacent Area.

Two Problems

The two problems which need correction must be handled separately; one, the surface flooding and the other, the removal of excess ground water and tidal flooding. Considerable work has been done to relieve flood damage by building up levees, clearing creek channels, cutting willow growth along banks, and other corrective measures. Much more of this kind of work is needed.

Channel Straightening

Considering this problem on a long-time basis, it may not be possible to hold permanently all of the creeks within their present channels. It may be necessary, particularly on the Guadalupe Creek, to do some channel straightening or to provide a by-pass for water that cannot be confined to the natural channel. A good opportunity is afforded for such a by-pass in the low ground paralleling this creek some distance to the east.

Effect of Subsidence

The difficulty of maintaining these creeks in their original condition has in recent years been aggravated by the sinking of the valley floor during the excessive ground water recession. Some parts of the valley settled as much as 6.1 feet, (see table 7, page 67) and it naturally follows that this uneven settlement caused a change in the water gradient of the creeks running into the bay. A reduction of five or ten per cent in the water gradient would cause a reduction in the velocity of stream flow and a much heavier silting of the creek bed than formerly occurred under a steeper gradient.[22] On the other hand an increase in the gradient would increase the speed of stream flow, tend to cause channel cutting, and make the existing capacity of culverts inadequate. Deepening, straightening and better maintenance of the channels is not the whole solution. Some provision must be made in planning such work for the ultimate volume of storm water which the cities are placing in the natural stream channels. San Jose is just completing its system of storm sewers. These and other unserved areas in the County are going to throw an overload on the existing drainage channels. In fact, the runoff in the valley floor can conceivably reach the same proportions as the present combined runoff from the valley floor and the hill area.

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22. Between the city limits of San Jose-Santa Clara and the Bay, subsidence has fattened the valley floor. Near Mountain View, Campbell, and Willow Glen, subsidence has increased the gradient.

Holding Ponds Required

A system of holding ponds is needed in the tidal area in order to store storm runoff waters during periods of high tides. Tidal gates then could release the storm waters in these basins to the Bay of San Francisco. Alviso and the lands between the Bayshore Highway and the Leslie Salt Company dikes are in effect such a holding pond today. Any diking of additional areas such as Alviso to provide protection from flood waters will back the impounded water waiting to reach the Bay at low tide upon rich agricultural lands. Areas needing further consideration of storm water holding pond development are:

> Palo Alto, for the Matadero, San Francisquito and Adobe Creeks.
>
> Mountain View-Sunnyvale, for the Stevens and Permanente Creeks.
>
> Alviso, for the Guadalupe Creek and its tributaries and the Coyote Creek and its tributaries.

A comprehensive plan for major storm sewers is also needed for this area.

Palo Alto, Mountain View, Sunnyvale, Cupertino-Saratoga and Los Gatos Areas

Storm sewers should be required of each subdivider to remove the surface runoff waters from his subdivision in this area. The County should provide a system of major storm drains which will empty into the existing drainage channels. All natural drainage channels should be maintained in a state of repair, be free from silt, and be adequately diked.

The Downer Avenue Area

It is recommended that this area remain in a non-residential agricultural use. The flatness of the area and the low absorption characteristic of the soil will make it difficult to dispose ofthe large volume of water which urbanization of the land would create.

The Evergreen Area

A study must be made of this area to determine which lands can be adequately drained of surface waters under conditions of urban use and which lands should remain in an agricultural use. A plan of major drainage channels in relation to the volume of expected surface runoff from future urban use must be prepared. From this an accurate conclusion can be drawn as to the potential urban development which can be taken care of through additional storm sewers construction.

South Valley Area

Cures for the flood hazard in this area include channel cleaning, bank protection and levees, by-pass channels to relieve creek bed overloading, and drain ditches for early removal of water from submerged areas.

Carnedero Creek

All of these possibilities should be studied, but thus far it appears that most of them would not be economically feasible. However, about a mile of levee and bank protection on Carnadero Creek near Gilroy seems justified. Part of the damage to farm lands is compensated by valuable deposits of silt from the flood waters.

Llagas Creek

Reopening of natural drainage channels in the Llagas Creek area is desirable and could be accomplished with proper cooperation of the land owners.

Soap Lake

Ground water drainage in the Soap Lake and Pajaro River district is more difficult, but offers bigger rewards if accomplished. At least 1,000 acres of good soil now of little value because of its high water table would become high priced farm land if properly drained. In the heavier soils tile drainage would not be feasible. Open drain ditches appear to be most feasible.

Land Use Adjustments

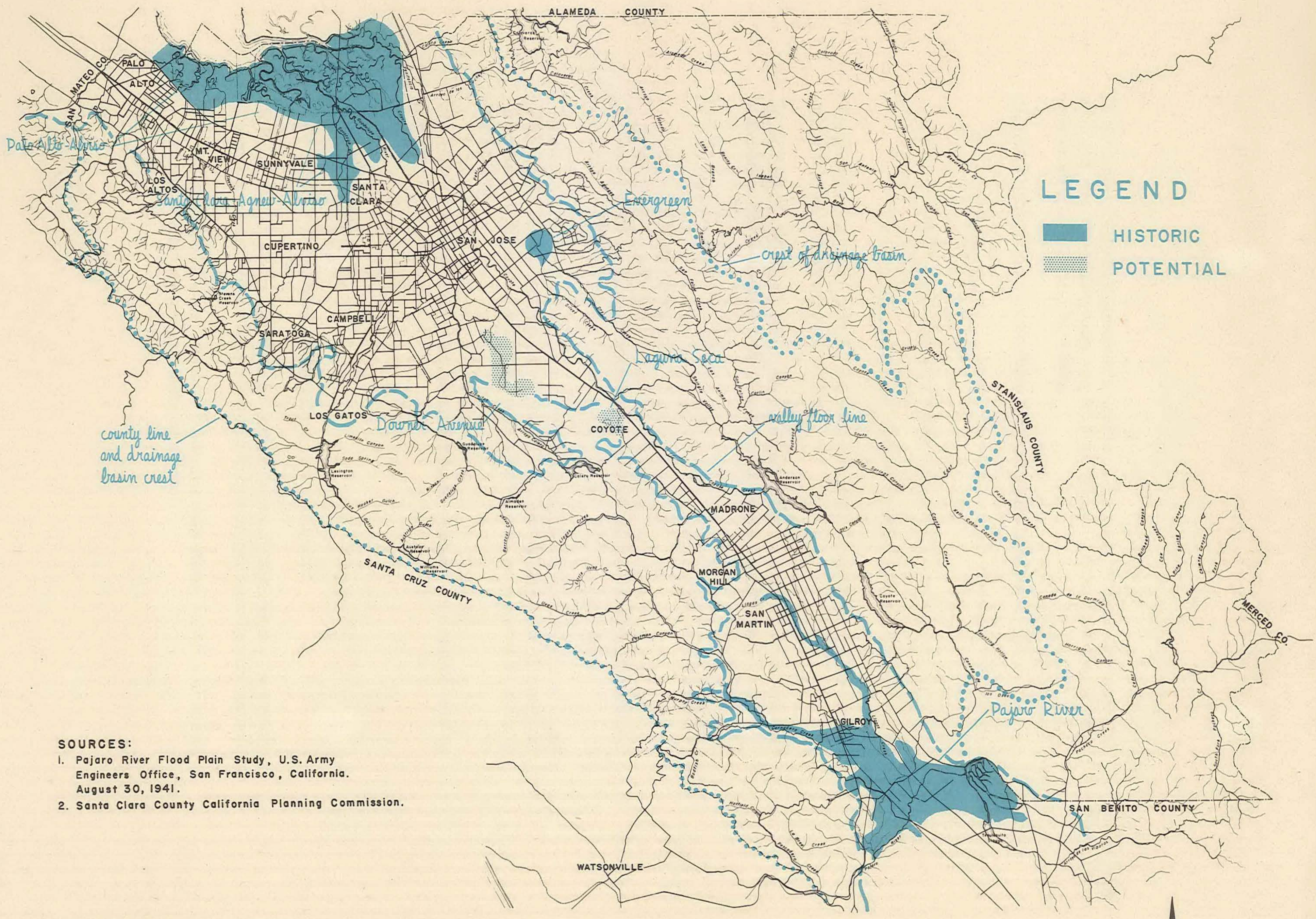
By way of enduring the incurable, readjustment in land use is the obvious solution. Low lands that will be ultimately waterlogged beyond redemption by any feasibe drainage should be devoted to grazing or shallow rooted crops, even at a loss of past investment in orchard or other development. Also, lands subject to insurable flood hazard should be devoted to crops that will suffer least from flooding and profit most from the resulting silting. Under no condition should lands subject to incurable flood hazards be used for residential use. If by-passes are found desirable to carry the peak of heavy floods, these should follow low swales where easements could be secured at reasonable cost and the land adjusted to the best use consistent with infrequent flooding.

Flood Plains

On examination of hydrographic conditions such as flood frequency, quantity storm runoff volumes, and physical and topographic factors, land subsidence and land inundation conditions during the past ten years reveal several flood plain areas.

South Santa Clara Valley

The army engineers in 1944 surveyed contours of the San Felipe Lake and Pajaro River Flood Plains. This flood plain area has been mapped with enough accuracy that flood plain zoning could be established here under existing California legislation.



SOURCES:

1. Pajaro River Flood Plain Study, U.S. Army Engineers Office, San Francisco, California. August 30, 1941.
2. Santa Clara County California Planning Commission.

FLOOD PLAINS

SANTA CLARA COUNTY PLANNING COMMISSION

North Santa Clara Valley

The County Planning Commission staff in 1952 with the help of aerials and field surveys established contours of flood plains. These flood plains were inundated from one to five weeks.

In north Santa Clara Valley these flood plain districts are:

Evergreen

Santa Clara-Agnew-Alviso

Lands adjacent to tidal dikes from Palo Alto to Alviso.

These districts shown as flood plains on the plate facing page 46 are recommended to remain in non-urban uses.

In addition to the above flood plain districts, the following areas are not suitable for urban uses because of soil and drainage conditions:

Downer Avenue

Laguna Seca

Alum Rock-Evergreen: area adjacent to the Evergreen Flood Plain.

Where possible, State and County highways should be located out of flood plain areas. It will be expensive enough to provide adequate drainage in other areas without the additional cost which would be involved in crossing flood plains.

Highways crossing flood plain areas should be designed to drain all waters readily.

Conclusions

As a result of the present investigation, it is concluded:

1. That the drainage problem in certain parts of this county is already serious and is destined to grow worse unless proper remedies are applied.
2. That subdivision of agricultural lands increases storm runoff and makes the storm drainage problem more complex.

3. That among the known causes of the present adverse drainage condition are:

    Surface flooding due to creek bed obstruction and silting.

    Retarded runoff because of closed or obstructed culverts and bridges. (Note: in some instances these structures were not designed to carry the required volume of storm runoff waters.)

    Inundation near the Bay is at least partially due to recent uneven settlement of the valley floor and partially due to the lack of tidal gates in the dikes.

    Local conditions of high ground water tables caused by over-irrigation, discharge of septic tank effluent in areas with an underlying hardpan, and seepage of water from higher elevations along the impervious subsoil.

    Local impervious surface soil conditions which allow little or no percolation of surface runoff into the ground.

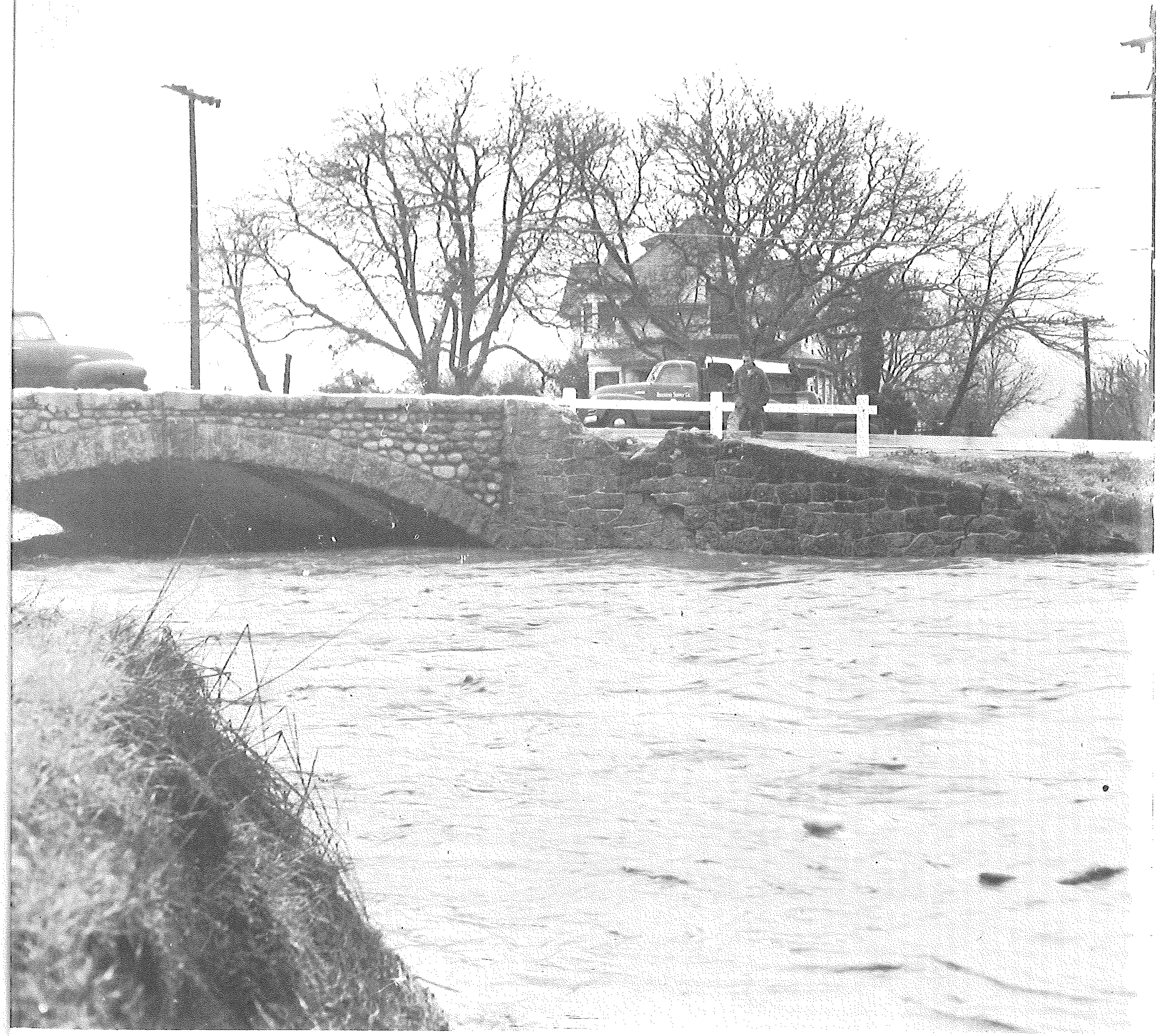
    Lack of an adequate County system of major and minor drainage channels.

4. That among the obvious remedies worthy of careful consideration are:

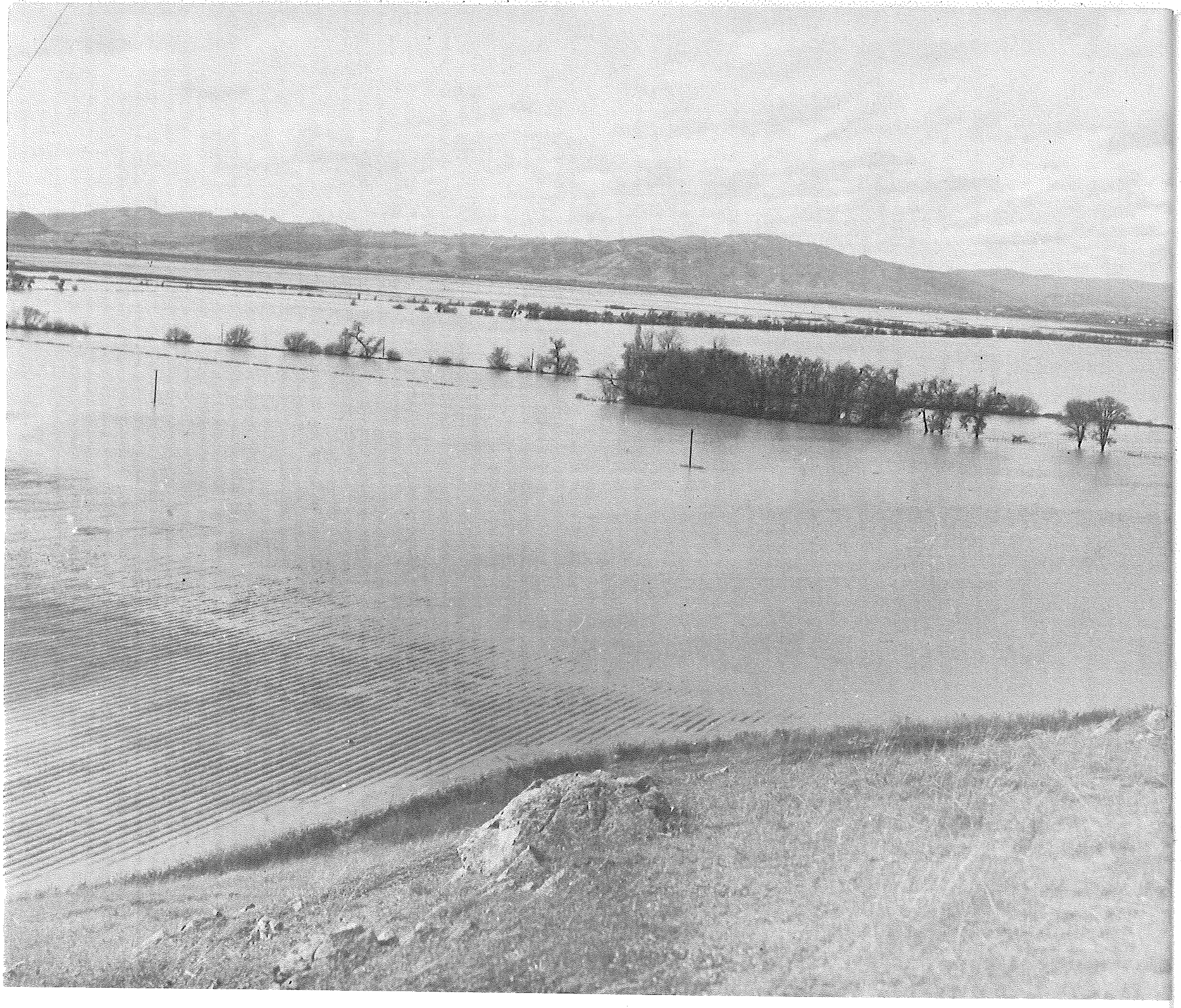
    Preparation of a county wide plan for flood control measures which are within the limit of economic feasibility.

    Re-opening of natural drainage channels.

    Construction of bypasses or drainage ditches to remove flood water with a minimum damage to properties.



January 16, 1952. Llagas Creek under bridge near Old Gilroy. Water in channel rose almost to top of banks before cresting about noon. Stream feeds into Soap Lake and the Pajaro River, which flows into ocean near Watsonville.



Waters of several creeks, including Pacheco and Llagas, spilled into lowlands southeast of Gilroy to form this large sheet of shallow water called Soap Lake. Lake is seasonal affair and shrinks to small area in summer. At the time of this picture, during the January floods, it covered an estimated eight square miles.

Where feasible and possible the construction of additional conservation dams to percolate more water to the underground reservoir, thus making the fullest use of all natural percolation gravels.

The alteration of the use of the land to meet flood conditions where it is impractical or impossible to prevent the inundation of the land.

Control of land use in inundated areas through flood plain zoning.

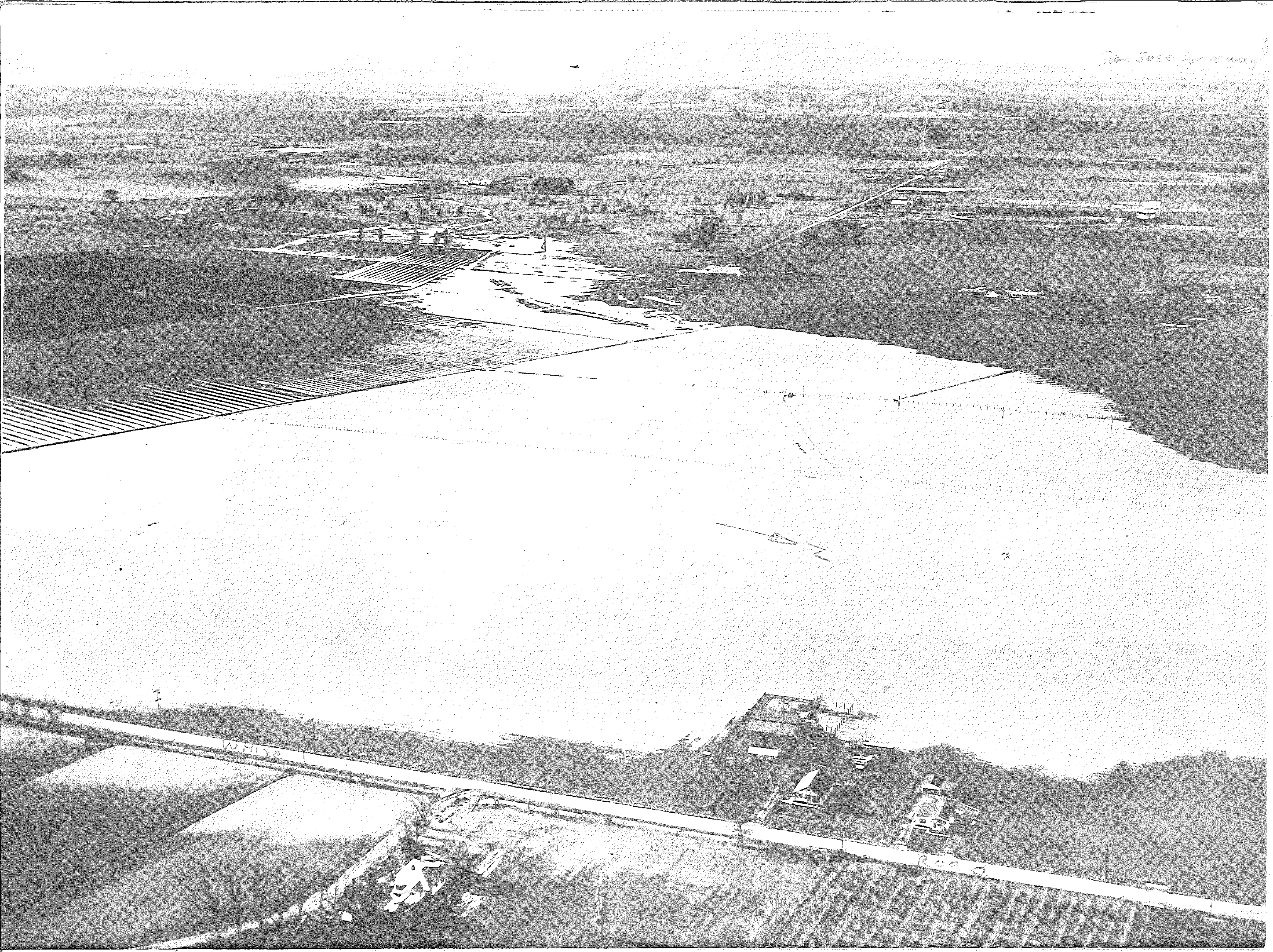
(The areas shown on the "Flood Plains" plate, facing page 46 have been checked during the last twenty years so that a contour line could be drawn around the land which is regularly inundated during a flood producing storm. The Army Engineers have done this for the Soap Lake district. The land adjacent to the tidal flats could be easily contoured by running a line of levels. In the tidal flat area everything below elevation 6.5 feet is subject to tidal flooding at the mean high tide. Flood conditions on the Guadalupe and Coyote have been designed by the Army Engineers, Santa Clara County Engineer, and the County of Santa Clara Planning Commission staff on separate years. In 1952 aerials were flown seven days after the height of the January 12 flood. These aerials show flood conditions in the tidal flat area, Guadalupe and Coyote area and the Tully and White Road area. In such instances as the above, residential subdivisions could be prohibited under the California Flood plain Zoning Law if the area is surveyed. The County has enough information to survey each area within the flood plains.)

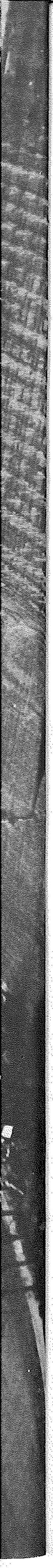
Recommendations

1. Drainage improvement should be accepted as one of the important factors in planning for this County.
2. Well-coordinated investigations and planning should be initiated at once to consider all the major factors herein mentioned.
3. All plans for local drainage improvement should be closely correlated with a master plan for ultimate development of the County and its resources.
4. Investigation should be started at once to determine the scope of a master storm drainage plan as well as the local drainage basins on the valley floor.
5. As a part of any overall drainage plan, attention should be given to the conservation and return to the underground water table of all possible storm runoff waters in order to avoid the overdraft which in the past has caused the sinking of the valley floor.
6. As a part of any overall drainage plan, a project should be initiated to clean and deepen all existing drain ditches in order to reopen former drains, and to straighten and construct such new drainage channels as are necessary to provide for storm runoff.
7. The Corps of Engineers, U. S. Army, should be requested to give early priority to the execution of such flood control measures on Coyote, Guadalupe and Carnadero Creeks and in the tidal flat area as their investigations determine to be feasible.
8. All subdivisions should be provided with storm sewers.
9. The problems of surface and subsurface drainage should be considered in relation to the problems caused by surface runoff, septic drainage and irrigation.
10. Special consideration should be given to the problem of increased runoff of storm waters which is being created by land subdivision.
11. Subdivision of lands subject to inundation should be restricted on the grounds of endangering the health and welfare of the community, this restriction possibly taking form in flood plain zoning.

Part 2: Contributing Factors

The Soil and Subsurface Drainage


San Jose spillway
N
White
Road



January 18, 1952. Fields northeast of Hillview Golf Club under water. The usually dry ditch, the old stream bed of Silver Creek, filled with flood waters from Evergreen Hills.

Foreword

Part 2 of this monograph contains information directly related to the geologic and topographic conditions affecting the drainage within the County. This section has been divided into four topics. Each of these topics bears positive relationship to the other. For the most part, this section of the report deals with subsurface drainage problems.

The topics are:

Geological Background

Underground Water Table

Land Subsidence

Interior Drainage of the Soil

Under the topic entitled "Underground Water Table," the aspects of the diminishing water supply related to drainage have been included. The overdraft on the underground reservoir has indirectly contibuted to the flood problem through land subsidence.

Highlights

Geological Background

Many of the factors relating to water and soil problems are directly related to the geological formation of the valley. The geological process is continuing today as is shown by land subsidence, active earthquake faults, erosion of the uplands, and alluvial deposits of streams.

Underground Water Table

During a 13 year period (1935-1948), there has been a continuous annual overdraft amounting to an average of 42,000 acre-feet in Santa Clara County. At present the changeover from a rural to an urban culture is increasing this demand upon the diminishing water resources of the County. This conflict between the rural and urban cultures results in increased competition for the use of these water resources.

Conversion of orchards to truck and row crops also increases the water demand. Industrial areas use more water than the same areas in orchard use, and urban residential areas use as much water as deciduous orchards.[23]

In many areas of the County there is not enough water to continue an agriculture culture. (Note: if these areas are converted to any other use the water problem will be intensified.) With a complete conservation program, the valley will still need to import water to satisfy the demands of its potential rural-urban development.

Land Subsidence

A direct relationship exists between the underground water table overdraft, lowering water tables, and land subsidence.

Dewatering of blue clays at a depth of approximately 300 feet in the pressure area of the northern valley is responsible for this subsidence.[24]

The topography and slope of the valley floor have been changed by subsidence, for example:

> Land subsidence has enlarged the level plain between San Jose and San Francisco Bay.
>
> This subsidence of lands adjacent to the Bay has caused recent tidal flooding of rich agricultural land.

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[23] See Bulletin No. 7, Santa Clara Valley Investigation, State Water Resource Board, 1951.

[24] Compaction of these clays can be permanent if they are turned to shale. However, land subsidence has not compressed the gravels of the underground water table. Geologically, compaction of these gravels is not possible.

Interior Drainage of the Soil

Subsidence and the diking of the San Francisco Bay in order to prevent flooding of the land from high tides has made it more difficult to take care of storm water runoff between the Bayshore Highway and San Francisco Bay.

A great deal of the land area of Santa Clara County will not readily percolate water into the soil.

Lands adjacent to the San Francisco Bay, San Jose, Evergreen and the Pajaro River have surface soils which are heavy, impervious clays with a very low permeability rate for surface waters.

Much of the valley floor is covered with a clay subsoil.

Water tends to seep along clay subsoils until it reaches the Bay or inland pockets, thus causing areas of high ground water tables and perched water.

Areas with a high surface ground water table and perched water bear no relation to a full underground water storage reservoir.

Heavy clays and a high surface ground water table create difficult foundation conditions and contribute directly to the surface runoff and storm drainage problem.

Much of the Santa Clara Valley cannot be adequately served by a minimum septic tank installation. In general this means that if these areas are subdivided sanitary sewers must be installed, or a large acreage size lot must be maintained.

Even with a large lot size, septic tank installations do not always work well.

In many districts with tight and impervious clay soils, the effluent from septic tank leaching lines comes to the surface of the ground.

In impervious soils there is a potential danger of the soil becoming septic when effluent from septic tanks is discharged into it.

Its foundations weakened by the turbulent rising waters of the Guadalupe River, this bridge on Branham Road, Robertsville, was near collapse at the time this picture was made. January 14, 1952.

Geological Background

Location

Santa Clara Valley is bounded on the southwest by the crest of the Santa Cruz Mountains, on the north by the San Francisco Bay, on the northeast by the crest of the Mount Hamilton Range, and on the south by the Pajaro River.

Valley Drainage

Near Madrone the Coyote River alluvial cone (the upper Coyote fan) divides Santa Clara Valley into two drainage basins. The northern basin drains into San Francisco Bay. The Southern basin drains via the Pajaro River into the Monterey Bay. Drainage is one of the factors that divides the valley into north and south areas.

Coyote River Cone

In the immediate geologic past the Coyote River has shifted on its alluvial fan discharging at times, as it does today, northerly into San Francisco Bay. On other occasions when the river changed its course the discharge was southerly into the Monterey Bay via the Llagas Creek and the Pajaro River.[25]

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25. C. F. Tolman and J. F. Poland, "Ground-water, Salt-water Infiltration, and Ground-surface Recession in Santa Clara Valley, Santa Clara County, California;" Part 1, Transactions: American Geological Union, p 24; 1904. This was discovered by the study of fresh-water fishes in streams discharging into San Francisco and Monterey Bays. See report of the United States Fish Commission, 1904; "Notes on Fishes of Streams flowing into San Francisco Bay," by J. O. Snyder.

North Santa Clara Valley

The principal valley, north Santa Clara Valley, having the northern drainage basin, is a nearly circular and bowl shaped area. The north-south dimension is the greater, being 20 miles; the east-west dimension is 13 miles.

Coyote Valley

At the southern end of the north Santa Clara Valley is a pass known as the Lower Gorge of the Coyote.[26] This pass, separating the encircling mountain ranges, opens into and is an extension of the main valley reaching as far south as Madrone. The total length of the Santa Clara Valley from Palo Alto to Madrone is 36 miles. The Coyote Valley and north Santa Clara Valley form the north drainage basin of Santa Clara Valley.

South Santa Clara Valley

South Santa Clara Valley is roughly triangular in shape, with its apex at Madrone. The distance from Madrone to the Pajaro River is approximately 17 miles.

Valley Structure and Formation

Santa Clara Valley is, essentially a "downdropped" valley, with relatively uplifted mountains on both sides. The geological formation of the valley was accomplished by complex faulting and folding around its margins. The same forces, acting probably at the same time, caused both the faulting and folding.[27]

Existing Earthquake Faults

The margins of the Santa Cruz and Mount Hamilton ranges are truncated from the valley floor by the active San Andreas earthquake-faults. The Haywards fault and the Calaveras fault join south of Gilroy. These faults truncate the Mount Hamilton Range from the valley plain. Farther south the Haywards fault joins the San Andreas fault. The latter lies at the base of the Santa Cruz Range.[28]

Geological History

In general, the geological history of the Santa Clara Valley is identifiable with that of the California Coast Ranges. This has consisted of periodic inundations of the land by the sea, separated by periods of uplift, faulting, folding and erosion. Bedrock was formed in the early and pre-Pliocene geological era. Rocks of the Santa Clara Valley are mainly marine and fresh water sediments. Bedrock is considered as non-water bearing in the Valley and underlies the water bearing strata.[29]

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26. This extension of approximately eight miles is known as the "Coyote Valley" or "The Narrows."
27. N. L. Taliaferro, "Geologic History and Structure of the Central Coast Ranges of California," California Department of Natural Resources, Division of Mines and Geology, Bulletin 118, pp. 151-159, 1943.
28. C. F. Tolman and J. F. Poland, op. cit., p. 24.
29. Bed rock lies several thousand feet below the surface; at San Jose and Moffet Field it is approximately 5,000 feet to bed rock.

Adobe Creek at corner of Edith and West Fremont Avenues in Los Altos, January 12, 1952.

Early Geological History

In the late Pliocene geological era fresh water streams and lakes were abundant from approximately the present location of the city of Morgan Hill to south of the Pajaro River. The marsh conditions of today in south Santa Clara Valley are the remains of lakes, such as Soap Lake and Laguna Seca. In this same geological era large alluvial fans were formed. At the time of maximum development of the fans the valley was nearly twice as wide as it is today.[30] During later geological eras the mountain ranges were raised and extended, the valley basin was narrowed and additional alluvial fans were deposited as well.

Recent Geological History

The disposition of the recent geological sediments has been in the form of alluvial fan, flood plain, and tideland deposits. The recent alluvium of Santa Clara Valley has been deposited over a period of approximately 25,000 years. The formation of the alluvial fans indicates that the streams wandered back and forth over broad expanses. This is shown today by abandoned gravel stringers which are not connected to active streams. The tideland deposits are responsible for the blue clays which form the pressure area of the underground water reservoir, as well as the present mud flats of San Francisco Bay. Flood plain deposits are responsible for much of the rich alluvial soils on the plains which are adjacent to San Francisco Bay and the Pajaro River.

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[30] See Bulletin No. 7; Santa Clara Valley Investigation, State Water Resources Board, 1951.

Underground Water Table—Santa Clara Valley

The most important structural feature in northern Santa Clara Valley, as far as ground water is concerned, is the gentle dip of alluvial gravels and the water bearing rock structure from the sides of the valley towads its center. The infiltration of surface waters into the underground reservoir takes place at the sides of the valley where the alluvial gravels and the water bearing rock structure are near the surface of the ground.[31]

Underground Water Reservoir

Recent alluvial gravels comprise the major reservoir for underground water storage in Santa Clara Valley. The depth of these deposits range from 1,000 to 4,000 feet. At present most of the water is obtained from underground reservoirs of no greater depth than 1,000 feet.

Pressure Areas

Pressure areas overlain by a confining blue clay strata exist in the central portion of the northern valley. [32] Generally this blue clay strata is found at a depth of approximately 300 feet. In the southern portion of the valley pressure areas exist near the Pajaro River. In these areas perched water on top of the blue clay strata is common but is not generally used as a source of water. These clays are the most important in the valley from a water supply standpoint, since they form impermeable and nearly horizontal barriers which confine the aquifers within the pressure zones. These clays also act as a barrier to the infiltration of salt water from San Francisco Bay into the underground water reservoir. The black tideland deposits around the southern end of the bay are unconsolidated equivalents of the deeper blue clays. The latter are thickest in the central part of the northern valley. This would indicate that an arm of the San Francisco Bay has been present there throughout most of the recent geological era. Assuming that conditions similar to those of today existed throughout this era, the extent of the deeper blue clays probably delimits the extent of the former tidelands. These blue clays are an oxidized form of tidal clays. See "Pressure Areas" plate facing page 24.

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[31] See Monograph by San Jose Chamber of Commerce, May 1952, reporting on Bulletin No. 7, State Water Resources Board, op. cit.

[32] These areas extend outward into the valley from the San Francisco Bay. See "Pressure Areas" plate, facing page 24.

A Dependable Water Supply Is Needed

Sources of Underground Water Supply

The source of the underground water is stream, rainfall, and percolation pond infiltration in the free ground water areas of the valley.[33] Once the water reaches the water table, it moves generally toward San Francisco Bay in the northern part of the valley and toward the Pajaro River in the southern part of the valley.

Overdraft

In a recent study it was found over a 13 year period, 1935-1948, that there has been a 34,000 acre-foot overdraft on the northern drainage basin underground water reservoir and an 8,000 acre-foot overdraft in the southern drainage basin of Santa Clara Valley. That is an aveage yearly water demand of approximately 42,000 acre-feet more than has yearly infiltrated into the underground reservoir.[34] In 1950 the water table was at an all time low.

Importation of Water Needed

The State Water Resources Board, the San Jose Chamber of Commerce, and the local water conservation districts have been studying the problem of securing a firm supply of water for Santa Clara Valley. Any solution will require not only the full use of waters now going to waste from winter rains but also the importation of water from some other watershed.[35]

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[33] Free ground water areas do not have the overlying strata of impervious blue clay that is found in the pressure areas. Percolation ponds are confined to these relatively few areas of the county near the hills where gravel strata makes direct contact with the underground water bearing rock and gravels.

[34] Bulletin No. 7, State Water Resources Board, op. cit.

[35] Ibid.

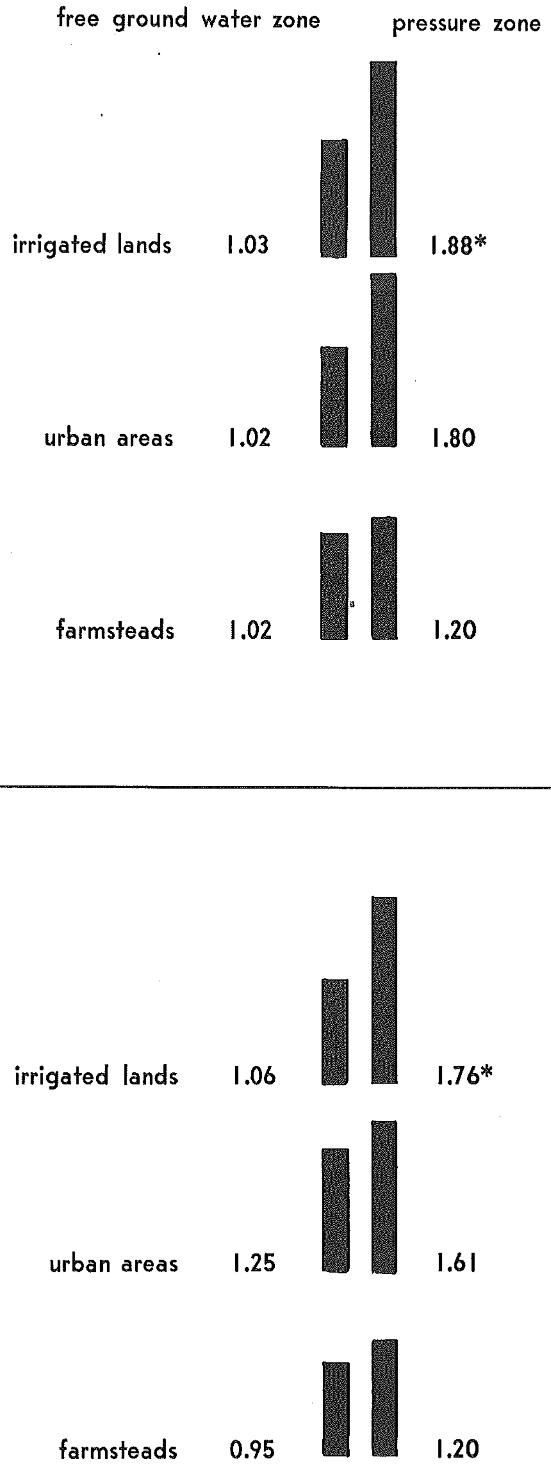

Table 5 Net Draft on Ground Water

Santa Clara Valley

Adopted from State Water Resources Board, bulletin No. 7, tables 34 and 35. Estimated Average and Mean Annual. Unit Net Drain shown in feet.

*In the pressure areas, truck crops, permanent pasture, and alfalfa predominate. These crops require approximately 20 to 25 per cent more water than either deciduous orchards or urban areas.

Table 6 Groundwater Levels

Santa Clara Valley

Average fall depths to groundwater, showing yearly fluctuation of underground water level through a 13 year period.

Adapted from State Water Resources Board, bulletin No. 7, table 12, based on data published by the Santa Clara Valley Water Conservation District.

year	feet
1935	124
1936	122
1937	108
1938	84
1939	101
1940	82
1941	63
1942	50
1943	55
1944	67
1945	79
1946	90
1947	109
1948	124

Change in Land Use

Homes vs. Irrigated Orchards

It is interesting to note at this time that in certain areas some orchardists have been turning their land either to urban use or truck crops as a solution to the lack of irrigation water. In other areas, non-irrigated lands have been subdivided for urban use. The point to consider here is that in withdrawing lands from an agricultural use because of an insufficient supply of irrigation waters, the water supply problem has been made more critical. Generally, irrigated orchards and urban require the same amounts of water while truck and row crops require from 20 to 25 per cent more water than either urban or orchard cultures. Unless an adequate supply of water for valley needs is obtained, the resulting competition between urban and agricultural interests for their share of the valley's water supply will be detrimental to both the agricultural and urban developments within the valley.

Conclusion

In 1948 Santa Clara County was taking approximately 42,000 more acre-feet from the underground water storage reservoirs than was being replenished each year. Santa Clara Valley's underground water reservoir is characterized by falling water tables.

The yearly overdraft has been the cause of land subsidence. Continued land subsidence is one of the factors which make the storm drainage problem a critical one.

Urbanization and a change over to truck and row crops will require an increasing amount of water over and above the County's present supply. The competition between urban and rural cultures for the existing water supply will be to the detriment of the rural culture.

Conservation of waters wasted into the San Francisco and Monterey Bays will help but will not establish stable yearly supply. This is due to the seasonal fluctuation of rainfall. Finally, in order to obtain a stable water supply to meet the future needs of the County for both rural and urban cultures, an outside source will be needed. This means that in the future, water will have to be imported into the County no matter how well the surface runoff waters are conserved.[36]

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[36] Monograph, San Jose Chamber of Commerce, op. cit.

Agnews Hospital area, January 12, 1952. Facing west on Horseshoe Drive parallel to Montague Road.

Land Subsidence—North Santa Clara Valley

Discovery

The 1920 leveling by the U. S. Coast and Geodetic Survey revealed a .014 of a foot discrepancy in the elevation of San Jose from the original 1912 leveling. In 1932-1933 a re-leveling revealed at the Hall of Records in San Jose that bench mark P7 had an elevation 4.05 feet lower than recorded in 1912. (See table 7, page 67.) Since 1932 a network of bench marks has been set up around the southern end of San Francisco Bay to check on the subsidence in this area. In the 1930's Fred H. Tibbetts explained this subsidence as follows:[37]

> "The change in volume in formerly saturated blue clay which has now been drained (by pumping) should account for the settlement . . . (the settlement) seems to be roughly proportional to the decline in the water plane at the different points."

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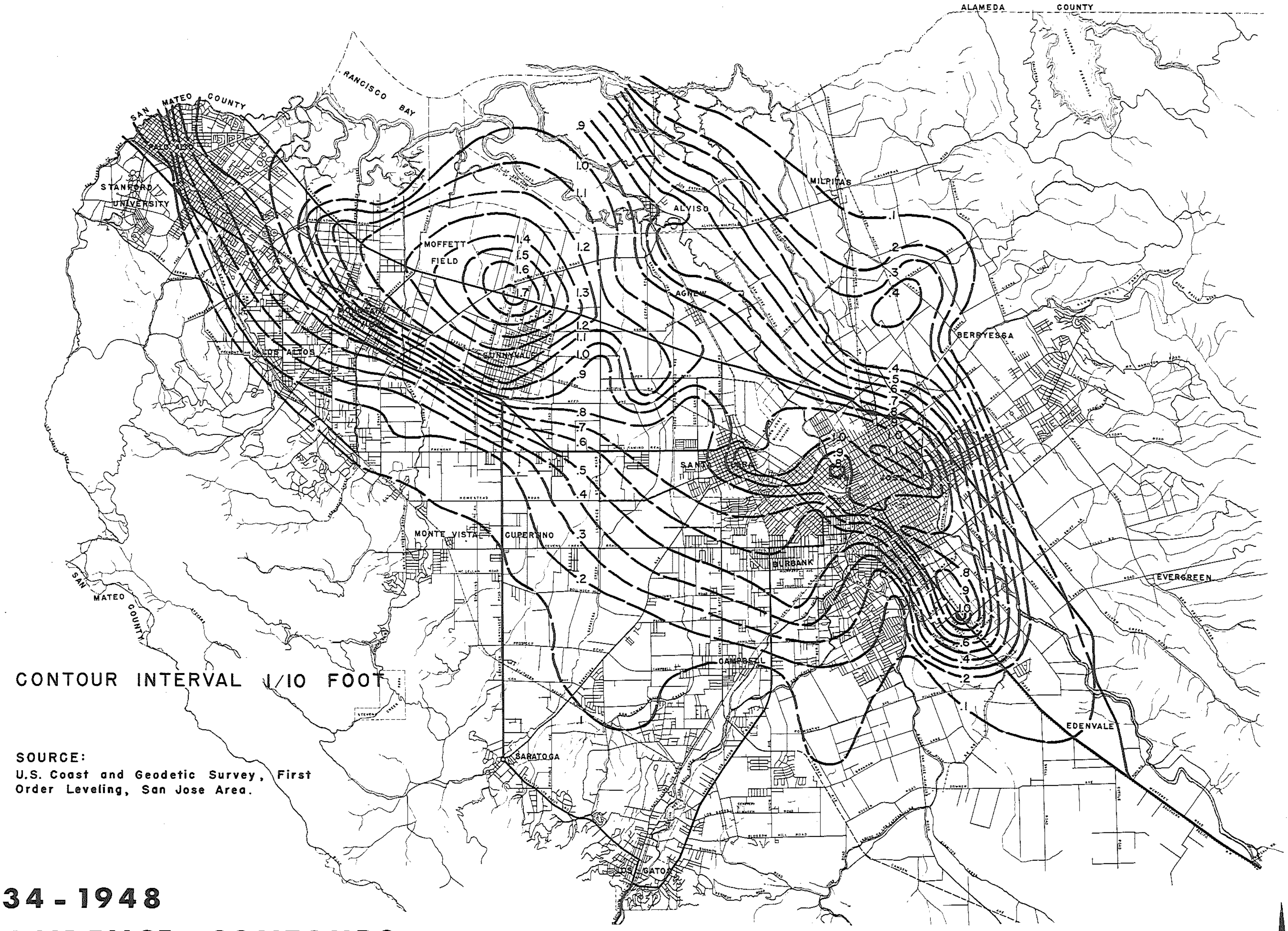
[37] C. F. Tolman and J. F. Poland, op. cit., page 29.



CONTOUR INTERVAL 1/10 FOOT

SOURCE:
U.S. Coast and Geodetic Survey, First Order Leveling, San Jose Area.

1934 - 1948
SUBSIDENCE CONTOURS

NORTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION

11-52

Summary of Data Available in 1952[38]

Area of Subsidence

Ground subsidence in Santa Clara Valley has affected an area of about 200 square miles.

Volume of Subsidence

The depression represents a volume of 52,000 acre-feet for the period of 1934-1938, and 240,000 acre-feet for the period of 1919-1948. This is approximately 15 per cent of the quantity of water pumped during these periods. (Note: The period of heavy pumping which has resulted in today's overdraft of 34,000 acre-feet on the underground water reservoir of north Santa Clara Valley began in 1910.)

Location of Area

The sinking is limited to areas underlain by dense blue clay. See "Pressure Areas" plate facing page 24.

No sinking has occurred within areas where adequate water table conditions exist, or in areas underlain by more than 40 per cent of sand and gravel.

In 1948 the areas of maximum sinking which contained deep wells were:

> Moffett Field, two at 1,000 feet deep.
>
> San Jose, one at 1,500 feet deep. There were others that were 1,000 feet deep.

The areas of maximum sinking in 1952 are again areas of maximum well production and well depth.

Measurable Criteria of Land Subsidence

The "rising" of well casings is common in the sinking area. Many of these casings have risen two to three feet above ground surface. (One old cemented casing at the Palo Alto Yacht Harbor which was originally at ground level stood five feet above the surface in 1941; a casing on the Will Weston ranch had a one foot differential in elevation in 1952.)

This "rising" registers the compaction of materials between the bottom of well-casings and ground-surface.[39]

Pump repairmen report that in the pressure areas of the northern valley, wrinkles frequently develop in deep well casings at about 200 feet. (This is within or near the blue clays where compaction is taking place.)

---

[38] C. F. Tolman and J. F. Poland, op. cit., p. 29; U. S. Coast and Geodetic Survey; Bulletin No. 7, Water Resources, op. cit.

[39] Water can be withdrawn from underground gravels which can be recharged to the same capacity each year. See also footnote No. 24, p. 48.

Sinking Ceased in 1937

Sinking of ground surface virtually ceased in 1937, three years after spreading operations were initiated by the Santa Clara Water Conservation District, and after a rise in average water levels of approximately 50 feet.

Subsidence Continued in 1939

In 1938-1939 there was a drop of the well water levels, and a continuance of the subsidence.

Correlation of Water Levels with Subsidence

This rise and drop of water level is reflected by a rise and drop of land surface, as is indicated by a comparison of tables 5 and 6.

Subsidence is continuing at a slower rate today due to the development of a more stable water table between 1937 and 1948.

In 1948 there was a recorded subsidence of 6.1 feet in San Jose, whereas the same bench mark in 1936 was 5.6 and in 1920 was 0.4 below the 1912 elevation. (See bench mark 0-7, table 7.)

In the twelve years between 1936 and 1948 at the same bench mark in San Jose there was only a drop of 0.5 feet in comparison with a 4.83 foot drop in the period between 1920 and 1936. (The period between 1920 and 1936 represents the period of greatest overdraft upon the underground water tables. (See bench mark P-7, table 7.)

Earthquake Faults

No significant ground movements have been detected along the San Andreas and Haywards Faults. The survey lines show small but irregular ground elevations to the east of Haywards Fault, but these are too small and too irregular to be considered indicative of earth movements along the fault.

Blue Clays a Source of Water

The blue clays of the northern valley have yielded about 4,000 acre-feet of water per year to the underground aquifers since 1935. When the water table is low, release of hydrostatic pressure on these clays allows the overlying sediments to compress them slightly. With the added pressure, water which fills the minute pore spaces between the particles of clay is forced into the underground aquifers equal in volume to that of the compression of the clays. One result of this compression is subsidence of the land surface.

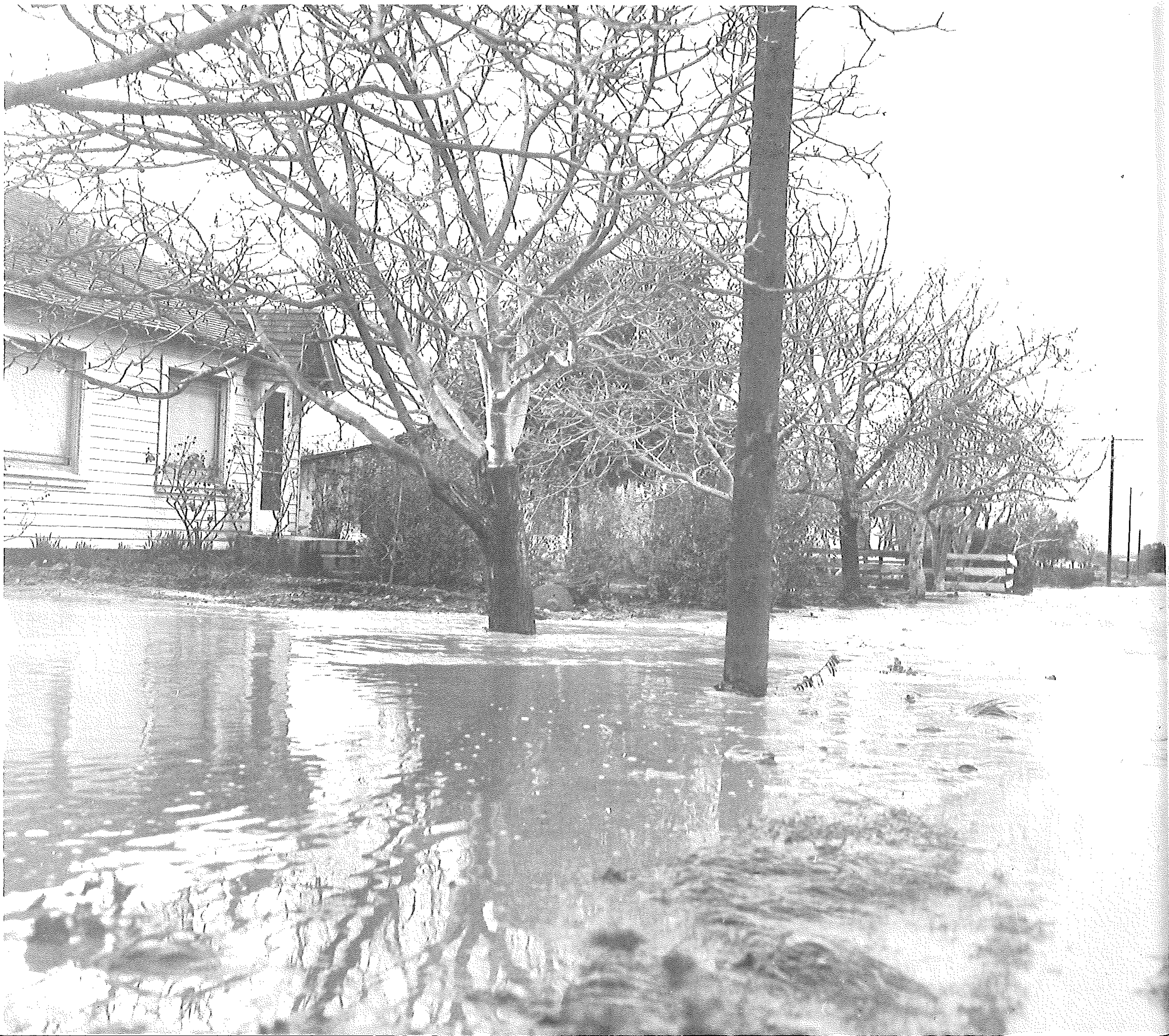
Land sinking is more pronounced in the vicinity of deep wells, which tap large numbers of aquifers and which drain a greater thickness of clay, than near shallower wells. See "Subsidence Contours" plate, facing page 64.

	B.M.	1920	1931-32	1932-33	1936	1940	1948
Alviso	Tidal 2			(est.) 2.0	2.50	2.86	3.07
Alviso	Tidal 3			(est.) 2.0	2.46	3.80	3.00
Coyote	P-19	00					00
Edenvale	L-19			0.38	0.51	0.43	0.42
Lawrence Station Road & S. P. R. R.	M-7		1.45	1.73	2.36		
Menlo Park	H-7		0.44	0.50	0.61	0.76	0.73
Palo Alto	I-7		0.35	0.41	0.47	0.56	0.60
Mayfield	J-7			1.70	1.81		
San Jose 1st & St. James Streets	P-7	0.34	3.66	4.05	5.17	5.51	5.67
San Jose 4th & Santa Clara Streets	I-19		3.41		4.87	5.15	5.28
San Jose Market & Bassett Streets	O-7	0.39			5.60	5.95	6.10
San Jose Tully Road	J-19			2.09	3.19	3.42	3.62
Warm Springs	T-7			0.19	0.21	0.25	0.26

Table 7 Approximate Settlement 1912-48

Source: U. S. Coast & Geodetic Survey, (unpublished) San Jose area. First Order Leveling.

January 1952. House of T. Passafiume on Cropley Avenue, East San Jose.



January 15, 1952. Intact roof over main portion of Russell Pierce home on Pierce Road, Saratoga, belies wrecked interior where tons of mud moved down from bank in foreground and pushed in walls.

Explanation of Land Subsidence

When the water level in the gravels of the aquifers rises, the pressure is increased. The drainage of clays is first reduced and then later stopped. If the original water table could be maintained the resulting pressure in the aquifers could force water back into the clay, causing it to expand. This expansion of the clays would make the land rise. However, it is felt that little if any rising of the surface would result from a continued pressure due to high underground water tables (Note: In some instances during the last few years a slight rise in elevation has been recorded; however, continued pumping during the period from 1943 to 1948 has shown an overall subsidence.)

Subsidence May be Irreversible

Whether or not volume recovery is complete, partial, or nil depends largely on whether the structure and mineralogic composition of the clay has been changed by compaction. The change of clay into shale by compaction due to geologic processes is irreversible.[40]

Correlation With Drainage

An examination of the "Subsidence Contours" plate, facing page 64, will show that the inland areas of San Jose and Moffett Field are sinking at a greater rate than the tidal flats along the San Francisco Bay. This means that the plain is flattening out between these two points and the bay. A direct result of the leveling there is a loss of gradient so that flood and storm runoff waters tend to wander sluggishly between the Bayshore Highway and the tidal flats. This is especially true today between San Jose and Alviso.

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[40] The dewatering of the blue clays does, however, have a direct effect upon the moisture content of the soil. When the clays are dry, moisture is taken from the top soils. When the clays have a stable water content, less irrigation is required in the upper soils. (Interview with Mr. Hunt, Water Conservation District.)

January 15, 1952. A new creek. Yamaichi Bros. ranch had running water in one of its barns at Cropley Avenue and Morrill Road when this small torrent swept across their property. Low lying areas in East San Jose bore the brunt of Mt. Hamilton runoff as spreading waters overflowed ditches and stream beds.

Berryessa

Interior Drainage of the Soil

Santa Clara Valley Soils

A graphic analysis and evaluation of the percolation characteristics (interior drainage) of Santa Clara Valley soils has been the aim of this section of the report. The material presented here gives an overall picture of the first six feet of the valley floor, and shows the location of soil types with similar absorption rates for surface and underground waters.

Accuracy of the Survey

Mr. Walter Weir, one of the University of California men who directed the work of this soil survey, has made the following comments concerning the accuracy of the 1947 soil survey:

> "The soil survey for Santa Clara County is one of the newest and most accurate ever made in the State of California. In fact, all soil surveys now being conducted are using the 1947 survey for the north-westerly section of Santa Clara County as a guide. This survey is 90 per cent accurate when the information is directly transferred to the ground from the published base maps, and 95 per cent accurate when the original base maps are used.[41] So complete is the soil type designation that there is only a variation within narrow limits. This is because the soil types have been broken down by color, texture and profile so that even blending areas between two soil types have been designated as separate types."

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[41] The original base maps were developed from aerial photographs. The scale of both the aerials and the map was four inches to a mile. The survey for South Santa Clara Valley is not as detailed nor graphed on as accurate a map as the survey for North Santa Clara Valley.

Soil Formation

Influencing Factors

The basic factors influencing soil formation have been included in the section entitled geological background. These factors, which influence the formation as well as the location of soil types, are erosion, shifting drainage channels, tidal flooding, weathering, and leaching and percolation of waters.

Erosion

The valley floor has been formed by alluvial deposits of eroded material from the uplands. During periods when the soils were being formed shifting stream beds were perhaps one of the greatest factors influencing the soil structure of Santa Clara Valley plains.

Shifting Drainage Channels

Soil profiles made from test boring, well cores, and excavations show that different soil types such as gravels, clays and loams are interlaced in fingerlike formations. In each succeeding age there has been laid down a different pattern of soil types so that today the resulting profile is one of stratification. For example, the individual beds of gravel are very irregular and porous. Clean gravels may grade into any combination of gravels, sands and clays which in turn may eventually pinch out or grade into either sand or clays. On the other hand, loams may have an underlying clay pan which in turn may overlay another strata of loam or gravel.

Tidal Flooding

During periods of inundation by the sea or lakes, clay and lime formations have been deposited on the valley floor. At a later date these early formations have in turn been covered with alluvial deposits from the uplands. Much of the lime in the area adjacent to San Francisco Bay has resulted from earlier shell fish beds.

Weathering

Another and equally important factor in soil formation has been the effect of weathering. As an example, weathering has turned many gravels into clay deposits.

Leaching

Water leaching and percolating through the soil tends to wash fine particles into the lower stratas. This action brings about the formation of clay in the subsoil and over a period of years will result in a heavy and impermeable clay pan. An example of this is the Castro soil series with their underlying hardpans.[42] Here over a long period of years newly deposited alluvial soils with deep and permeable subsoils have been changed into soil series with a subsoil of clay hardpan.

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[42] In the Castro soil series difficult foundation conditions for building may be expected.

Dense and Impervious Subsoil Contours

The "Subsoil Conditions" plate, facing this page, shows the areas covered by impervious subsoil conditions. These contours do not necessarily indicate continuous layers of impervious material. However, the interlaced fingers of such impervious material are so related to each other that it is exceedingly difficult to percolate water into the soil. In most instances the water that reaches this impervious subsoil runs along the clay pan until it reaches the tidal marshes or until the clay stratas come to the surface of the ground. In the "Subsoil Conditions" plate, the contours have been separated into tidal flats, subsoils with a hardpan, and subsoils with a dense or moderately dense clay pan.[43]

Percolation Contours

Presence of Salt

Several criteria indicate soils having poor percolation characteristics or interior drainage. These criteria are presence of salt, restricted drainage due to impervious subsoils, silt, clay and other tight surface soil types, and percolation tests made by the U. S. Department of Agriculture and the Santa Clara County Health Department.

In most instances, the areas in which salt concentrations exist are directly traceable to an impermeable subsoil which allows an accumulation of salt and maintains a high water table in the soil. The high water table may be the result of one or more conditions: saturation of the soil by tidal flooding from the Bay and natural, and man made dams which block the flow along the impervious subsoil.[44] Pockets are created which form large areas of perched water, and in some instances these high ground water tables are at the surface of the ground, thus forming swamp areas.

Restricted Drainage

Impervious layers of clay restrict the permeability of the soil. Where these layers are on or near the suface of the ground very little water is able to percolate into the soil. Water stands sometimes three or four days after irrigation. In all cases water which reaches these impervious layers travels laterally until it either reaches an outlet and is able to seep into a water course, or enter the San Francisco Bay. In many instances where cuts have been made by road excavations water has been seen to seep along the top of an impervious layer while the soil below this clay pan or rock remained dry.

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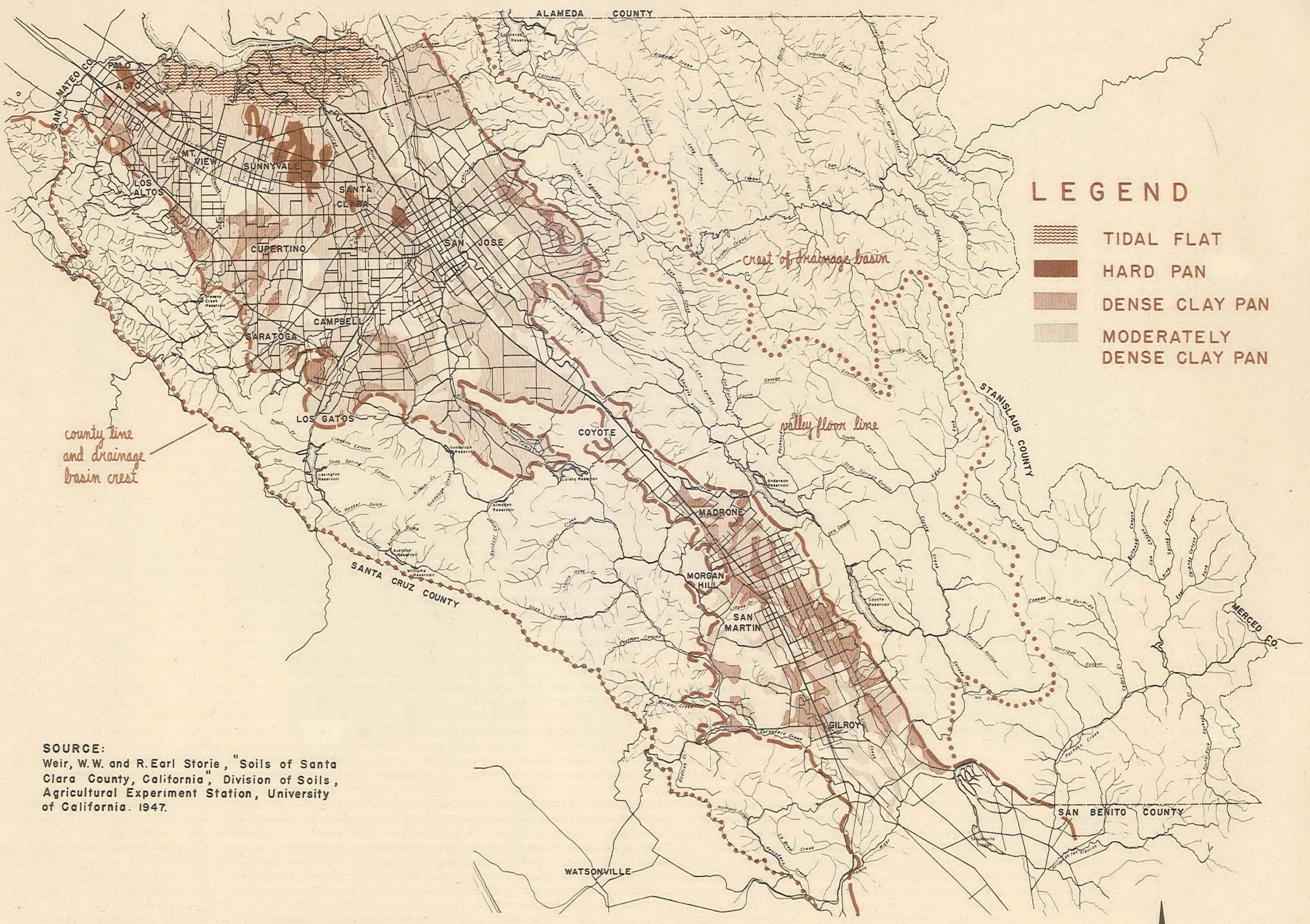
[43] See Supplement No. 1, Section A, for tabulation of this information by soil types.

[44] Roads form an inverted dam. In many instances expensive tile fields have been required to drain ground water accumulated behind these dams.



SOURCE:
Weir, W. W. and R. Earl Storie, "Soils of Santa Clara County, California", Division of Soils, Agricultural Experiment Station, University of California. 1947.

SUBSOIL CONDITIONS

SANTA CLARA COUNTY PLANNING COMMISSION

11-52

Perched Water

Water percolating into the soil by irrigation or other seepage runs over the surface of an impervious clay pan until it finds a pocket or a soil dam. An accumulation of this seepage has caused high ground water tables near the surface such as exist in the Evergreen area of the County, the tidal plain adjacent to San Francisco Bay, such highways as El Camino, The Bayshore, Southern Pacific Railroad and similar roads. The presence of a high ground water table is not an indication of full underground water storage reservoirs. At times during the past twenty years the water table of the underground water reservoir has been at a very low level. Tests taken during these seasons in perched water areas have shown a waterlogged condition.

Impervious Surface Materials

Silt, clay and other tight surface materials will not allow surface runoff waters or underground seepage to percolate into the lower stratas of the soil.

Percolation Test

In order to properly tell how much and how fast water can penetrate into a given soil type, tests must be made. These tests, called percolation tests, when properly conducted will give the absorption rate of any given soil type for any given liquids. Different liquids will have different absorption rates in the same soil type. Septic tank effluent generally requires more absorption time than rain or irrigation waters.

Source

When the soils of Santa Clara Valley were classified as to type, percolation tests were run demonstrating the amount of time required for irrigation waters to penetrate the various soil types. (This data in its tabulated and mapped forms has been one of the sources of this survey.)

Method

As a check and a refinement on the University of California Agricultural Extension Service drainage classifications and percolation tests, data developed by the Santa Clara County Health Department has been used. The Health Department makes test boring and percolation tests in each new subdivision to determine the characteristics of soil in relation to its absorption of effluent from septic tanks.[45] Knowing the location of each subdivision, these ratings of the Health Department were placed upon a percolation contour map evolved from the Extension Service drainage classifications. Using the information developed by this procedure a new tabulation of soil classifications was made which reflected actual experience with septic tanks.[46] The percolation contours shown on the plates facing pages 74 and 74a, indicate these general areas.

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[45] See Supplement No. 1, Section B, for tabulations.

[46] See Supplement No. 1, Section C, for tabulations.

Use of Mapped Percolation Contours

However, due to the inadequate coverage of Santa Clara County, individual percolation tests must be run for each land area in order to determine the exact rating of each soil type. This is especially true when determining the individual soil type's percolation characteristic for the absorption of effluent from sepcit tanks. The County of Santa Clara Health Department performs this service in connection with its approval or disapproval of a design for a septic tank installation.

Classifications

The contours have been divided into six classes. The profile depth of each class is six feet.[47] Within each of the classifications the following general conditions can be expected:

Class I: Good percolation characteristics.
These soil types are light textured recent alluvial loams with the subsoils the same as the surface soils. Permeability is good to excellent.

Class II: Good percolation characteristics.
These soil types are heavy textured silt, clay, and gravelly loams. The subsoils are of a light clay. Depth of surface soils vary. Permeability is fair to good. This class includes some gentle rolling terrain.

Class III: Made up of Class I and II soil types that are subject to periodic inundation. (Such conditions as flooding would tend to make septic tank installations in subdivisions unwise.)

Class IV: Fair Percolation.
These soil types are light and medium textured clay loam, silty loams, gravelly clay loams and shallow phases of Class I and II soil types over basin clays. Depth of soil varies with some shallow deposits of permeable soils over basin clays. Subsoils are light to medium clays. Permeability is fair to poor. There is a great variation in the adaptability of the soil for the disposal of septic tank effluent. This area sometimes calls for more than the minimum requirements in the installation of septic tanks and their leaching lines.

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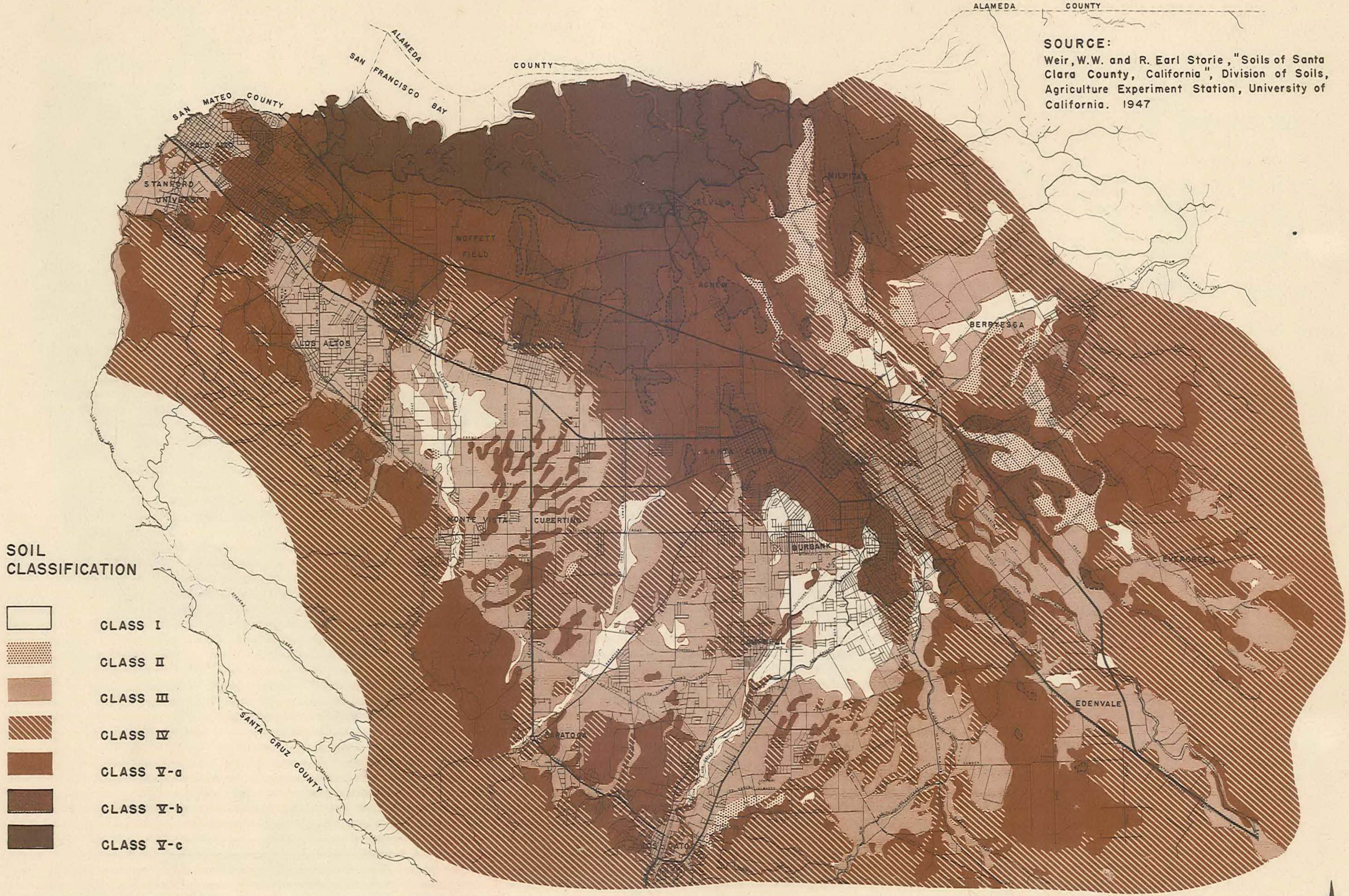
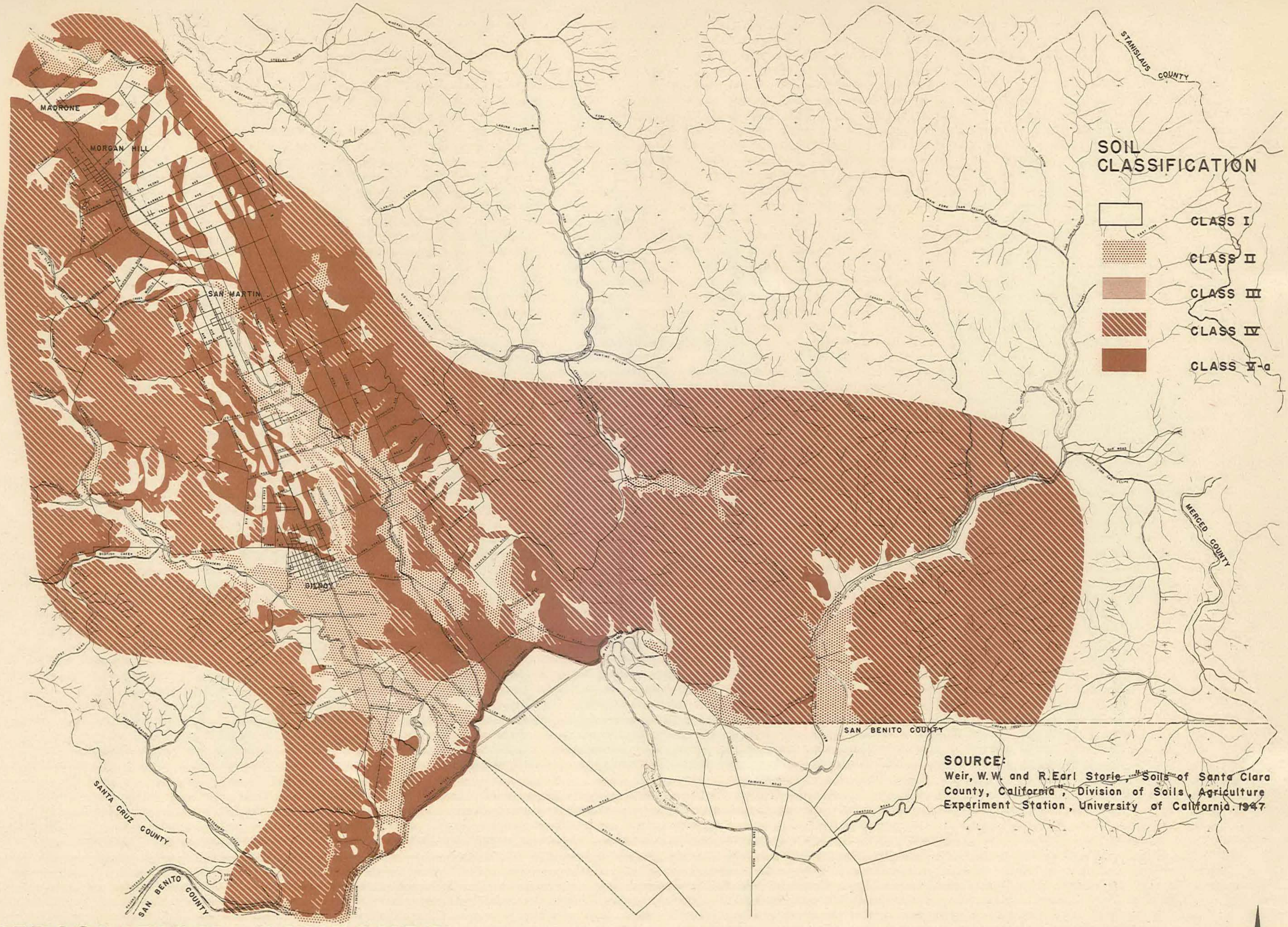
[47] See Supplement No. 1, Section C. The use of these percolation contours becomes more valuable in the light of the recently adopted policy of the State Regional Water Pollution Control Board which sets up rigid qualifications and standards for septic tank installations.



SOURCE:
Weir, W.W. and R. Earl Storie, "Soils of Santa Clara County, California", Division of Soils, Agriculture Experiment Station, University of California. 1947

PERCOLATION CONTOURS NORTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION

11-52



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PERCOLATION CONTOURS

SOUTH VALLEY, SANTA CLARA COUNTY PLANNING COMMISSION

CLASS V-A: Poor percolation characteristics. The soil types are heavy clays, silty clays, and upland soils with some of the more permeable soils in a shallow phase over basin clays. Subsoils are medium or heavy clays, hardpan or other impervious material. Depth of soil varies and there are some slopes over three per cent. These soils generally have restricted drainage with a permeability rating of poor to very poor. One can expect to find high ground water conditions in this class, as well as periodic flooding. If satisfactory for use of septic tanks these soil types will require special means of establishing disposal fields. Foundation conditions are generally a problem in this class.

CLASS V-B: No permeability as these soil types are found in tidal flats or swamp areas. Soil types are heavy textured muck, peat, or tidal marsh. Since the soils are waterlogged, they present impossible foundation conditions and are not adaptable for the disposal of effluent from septic tanks. Subdivision should not take place in these areas.

Salt Water Infiltration

CLASS V-C: Tidal flats. No permeability. Salt water infiltration by test has been found to range from zero to 100 feet in depth of penetration into the soil. Most of this infiltration has occurred in areas subject to tidal flooding —areas which are increasingly due to land subsidence. In 1940 quite a high percentage of salt water had infiltrated into the underground water reservoir. The source of this infiltration was found to be seepage of saline water from tidal percolation into uncapped wells. Saline water seeping into the uncapped wells then was able to bypass the impervious blue clays into the underground reservoir.[48]

Tests in 1949 revealed that the salt concentration within the underground reservoir was approximately the same as that recorded nine years before. In an analysis of these figures the State Water Conservation Board arrived at the conclusion that salt water intrusion into the underground water reservoir has stopped. The report stated in part that:[49]

> "Waters in 30 of the wells used in 1940 by Tolman and Poland to locate the fringe of pollution were resampled in 1949 and tested for chloride content. Comparison of the recent and antecedent analysis showed no appreciable change in chloride concentration at these wells during the nine years. This indicates that no significant inflow of saline waters through pressure aquifers from beneath San Francisco Bay has occurred to date, and that pollution of deeper pressure aquifers by perched ground water has not generally increased, with the exception of possible pollution of ground water in the Palo Alto area."

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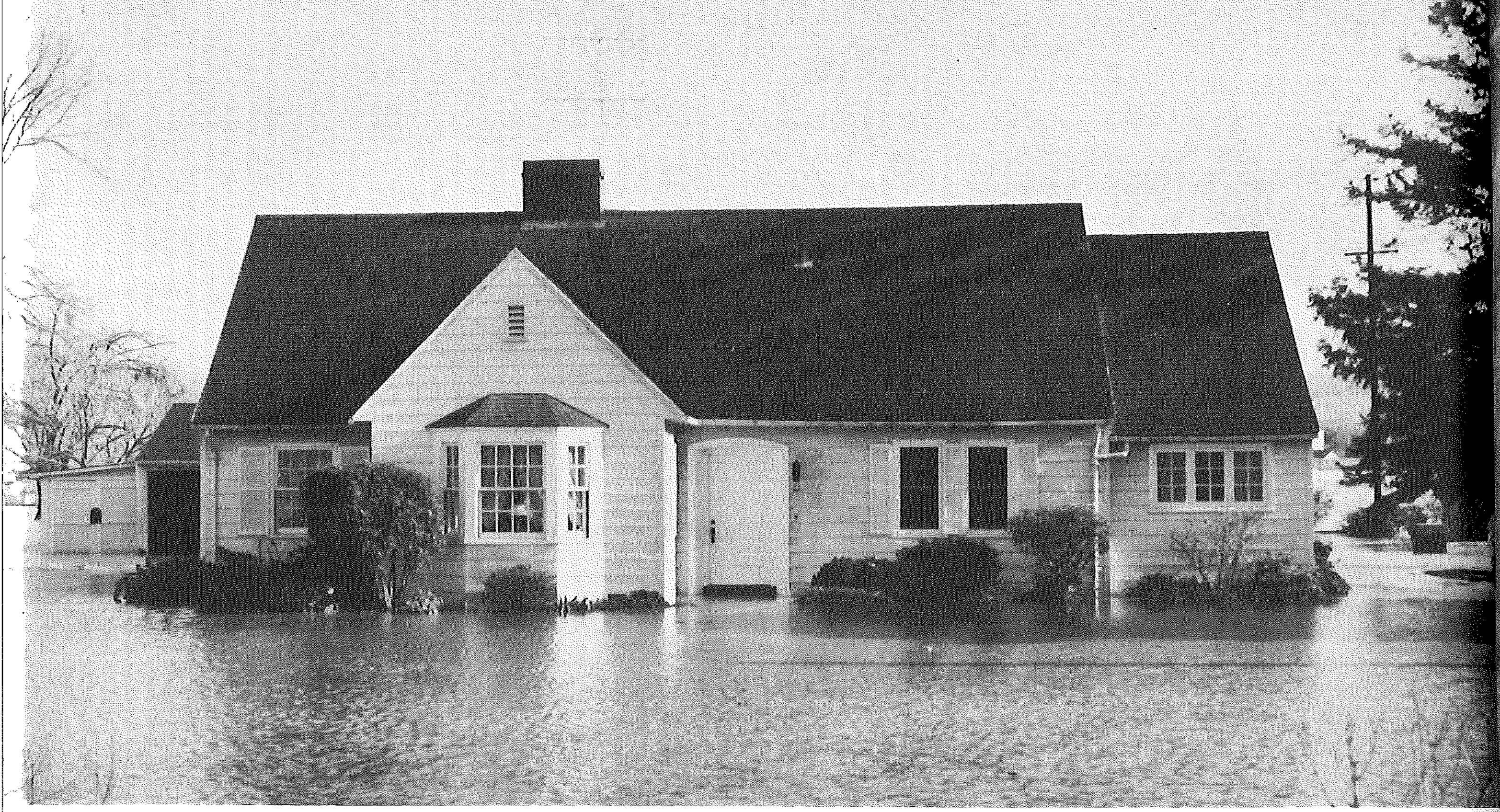
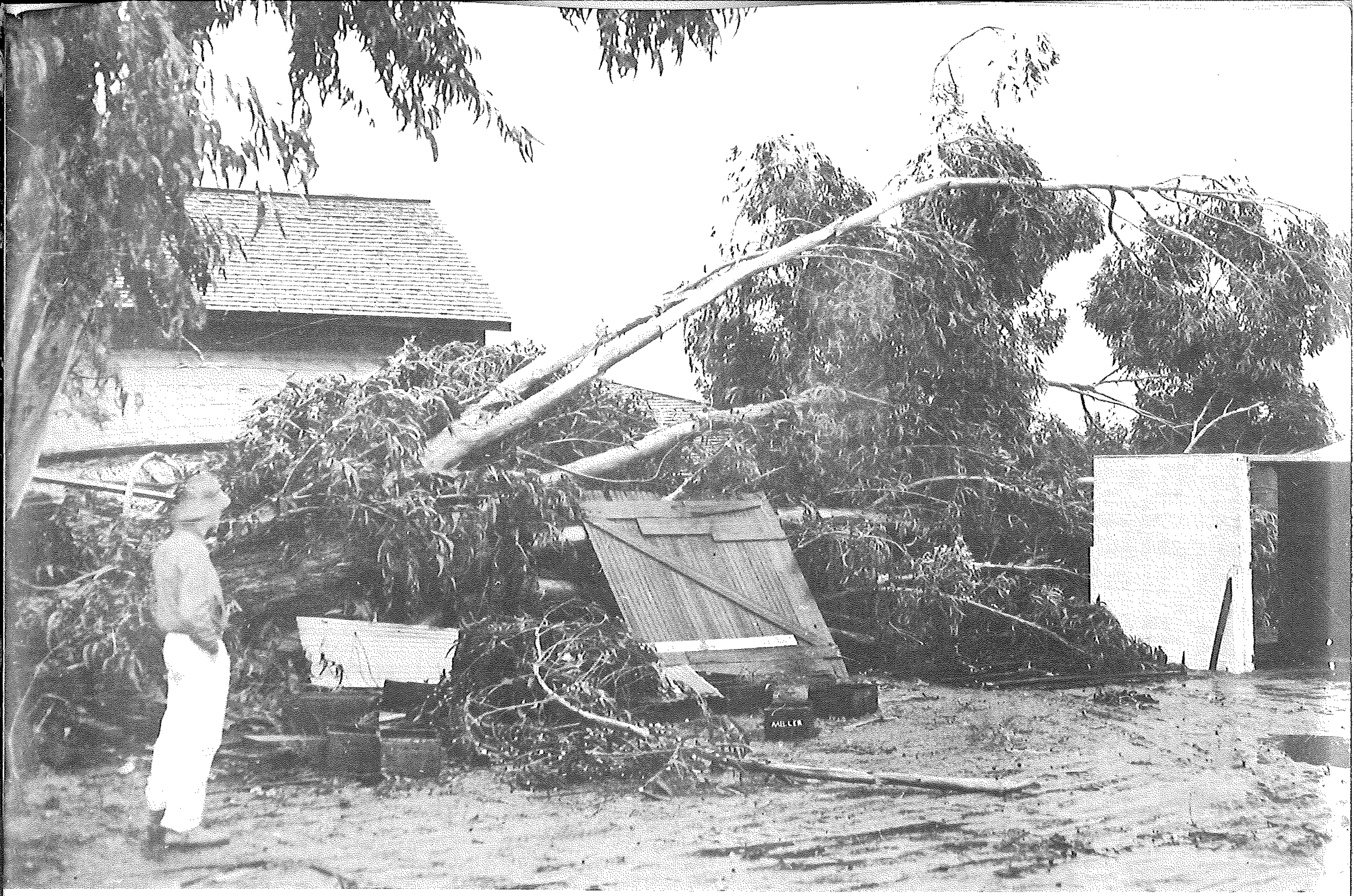
[48] These clays are generally found at a depth of 300 feet. Since this depth is greater than salt water penetration, uncapped wells or dry artesian spring courses would be the only way for salt water to reach the underground reservoir.

[49] See Bulletin No. 7, State Water Resources Board op. cit., 150, p.



Fire Marshal's residence, Agnews State Hospital, January 12, 1952.



Costly storm incident, Santa Clara County, January 1952

Part III: Appendix

CONTENTS OF SUPPLEMENTS I, II, III

supplement I:	**section**	A	Subsoil conditions restricting drainage.
		B	Record of percolation test made by the County of Santa Clara Health Department.
		C	Classification of soil types in relation to percolation characteristics.
		D	Policy of State Water Pollution Board regarding water pollution in the Bay region.
		E	Table of land subsidence in Santa Clara County.
supplement II:	**section**	1	Investigation of flood control and storm drainage problems by the California State Water Resources Board.
		2	Copy of a letter from Don Reinohl regarding Alviso flood control problems, February 1952.
		3	Memorandum to the County Executive concerning flood control survey, Corps of Engineers, U. S. Army, January 1952.
		5	Letter stating conclusion and recommendations on the report of the problem of storm water disposal adopted by the County of Santa Clara Planning Commission.
		6	Conclusions and recommendations with reference to the problem of storm water disposal, Santa Clara County, November 1949.
		7	Letter from Mark Thomas with reference to the proposed flood control survey, June 1949.
		8	Additional data to the County of Santa Clara Planning Commission from Mark Thomas regarding proposed plan for storm sewers, July 1949.
		9	Recommendations for the solution of storm water drainage problems in Santa Clara County by Engineers Club, San Jose, September 1949.
supplement III:			Santa Clara Flood Control Act, as amended in 1952.

*These supplements have been published separately in another book and may be had upon written request to the County of Santa Clara Planning Commission.

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COUNTY OF SANTA CLARA BOARD OF SUPERVISORS

chairman	William S. Pfeifle
	Dr. Earl C. Campbell
	Joseph M. McKinnon
	Arthur W. Brown
	E. O. Wool
county executive	Frank H. Thill

COUNTY OF SANTA CLARA PLANNING COMMISSION

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	vice-chairman	Chester Root
		W. W. Curtner
		Christian Wilder
		Charles Kuhn
		Will B. Weston
Ex-Officio members	*supervisor*	E. O. Wool
	county counsel	Howard W. Campen
	county engineer	Leonard Bushnell

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	Jesse S. Smith
	Robert R. Fedde
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	Hazel Callahan
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TUCKER PRINTING AND LITHOGRAPHY, SAN JOSE

[illegible]

I have been [illegible] of correct observations [illegible] the strata passed through in sinking [illegible] wells. I am informed that there is much variation in the substances brought up by the [illegible] from the same depth in different localities. After passing through the alluvium, from 12 to 30 [illegible] in thickness, a bed of blue clay is passed, then yellow clay is usually struck, which continues to different depths, alternating with the blue clay and beds of gravel, until at a depth of 200 feet, a hard [illegible] occu[illegible] [illegible] in which the stream [illegible]

A very singular feature [illegible] about these wells is the great [illegible] of wood, coal, shells, and other [illegible] remains, which are brought up [illegible] all depths. Pieces of redwood, [illegible] bones etc., are very often met with [illegible] lowest depth to which wells have been bored. Sea shells have been found in the clay, at a depth of 60 [illegible]. A piece of deer's horn was once brought up from a bed of gravel 140 feet [illegible]. In another instance a redwood log 4 feet in diameter, and partly [illegible], was bored through at a depth of [illegible] feet; bones were found in the same well, at 3[illegible] feet depth. No stratified [illegible] have ever been met with, although large boulders are often encountered, also beds of small pebbles and cobble stones, worn round and smooth by the action of running water. The specimens of wood sometimes have an appearance of freshness and indestructibility truly wonderful, considering the great length of time which they must have been buried in the ground; others are partly petrified, and appear to have been imbedded at a more remote period.

I have taken considerable pains to ascertain the probable cause of the failure of so many artesian wells at different periods since their completion. By some it has been attributed to earthquakes, which may have changed the course of the subterranean streams. Others [illegible] thought that the streams have [illegible] gradually failing from the great [illegible] made upon them by so many wells; while others contend that if a well is properly piped to the bottom and kept clear of sand and other obstructions it will continue to flow without diminution, unless the scarcity of rain is such as to materially diminish the mountain streams and lagunas, or reservoirs in which case the wells must necessarily partially fail. Many wells which have ceased to flow, still have sufficient water nearly level with the surface to supply large pumps worked by wind-mills—a process very much practised in this vicinity, for irrigation.

This matter presents a peculiar subject for investigation, involving as it does many of the most interesting principles of natural science. Too little attention is paid to it by men competent to make its details of service in compiling and arranging the natural history of this State, which, of all others, presents the widest possible field for such research, and upon which the complete development of its resources so much depends. For much information relative to artesian wells, I am indebted to Messrs. Gould, McLaran and Barker, who have long been engaged in the business in this county.

The following tabular statement of the amount of rain which has fallen during four years past, is from observations made by Dr. G. B. Crane, of San Jose, and may be relied on as correct.

	Inches.		*Inches.*
1853—Sept.	0.19	1854—Jan.	2.50
" Oct.	0.19	" Feb.	2.50
" Nov.	1.95	" Mar.	1.[illegible]
" Dec.	0.50	" April	[illegible]
		" Oct.	[illegible]
		" Nov.	[illegible]
		" Dec.	[illegible]
1855—Jan.	1.05	1856—Jan.	[illegible]
" Feb.	0.95	" Feb.	[illegible]
" Mar.	2.[illegible]	" Mar.	[illegible]
" Apr.	0.70	" Apr.	[illegible]
" Dec.	2.05	" May	[illegible]
1857—Jan.	0.38	" Nov.	[illegible]
" Feb.	[illegible]	" Dec.	[illegible]
" Mar.	[illegible]		
" Apr.	[illegible]		

[illegible] amount of rain which has [illegible] in November and December, of this [illegible] [illegible]en. I think it is [illegible] the same months in any preceding year [illegible] the above table.

[illegible] have been confirmed [illegible] Court, and the appeals [illegible] District Attorney. The [illegible] few, however, have been [illegible] the U. S. Surveyor General, [illegible] many cases there is so much doubt [illegible] location of the boundaries [illegible] result of the many litigations [illegible] [illegible] claims, involving nearly all [illegible] titles, that settlers are unable to determine of whom to purchase in order to acquire any better title than that of possession or pre-emption. Instances are common of persons wishing to make improvements being obliged to *quiet* half a dozen titles of different shades [illegible] dimensions, before they deemed the[illegible] secure in the possession of the[illegible] chases.

Great numbers of grants are [illegible] fore the U. S. District Court, [illegible] others are awaiting final adjudicati[illegible] the Supreme Court of the United St[illegible].

It is obvious that such a state of things must very materially retard the progress of improvements, and the development of the agricultural resources of any country. In my opinion it would have been far better, upon the first opening of the U. S. Land Commission, to have recognized and confirmed every shadow of a claim in the country, and closed the business at once, thereby putting a stop to the manufacture of fraudulent titles, and providing a way for the lands to pass into the hands of the settlers by purchase, upon a secure title. The delectable system of squatting would then have been unnecessary, and all its attendant evils averted.

It is generally understood that as soon as matters are properly arranged, settlers will have an opportunity to purchase at a comparatively low price; $10 per acre has been mentioned. But little dependence, however, can be placed in the lenient representations of either the claimants or of [illegible] into whose hands [illegible] have passed.

School Land Warrants have been located in this county since its organization, upon [illegible] acres of land; copies and certificates of which several locations have been duly transmitted to your office. I would remark in this connection that there is much discussion in certain quarters, as to whether School Land Warrants can be legally located except where the public land has been sectionized, and the plats returned by the U. S. Surveyor General.

I am [illegible] by a gentleman whose official [illegible] the U. S. Land Register office [illegible] indicate an understanding of the matter, that it is the case that they cannot be located except through that office. The Township lines, only, have been surveyed in this county. I would suggest that you give particular instructions upon this point. I have no desire to profit by the erroneous opinions of parties holding these warrants.

No public roads of any importance have been surveyed in this county since the report of my predecessor, to whose remarks upon the subject I would respectfully refer; they cover the entire ground and leave nothing more to be said at this time, except that the survey of several county roads is in contemplation, which will be duly reported to your office.

There are many excellent Schools and Seminaries in this county. The Santa Clara College, at the town of Santa Clara, was founded in 1851, and has since been incorporated by an act of the Legislature. It is under the management of the Fathers of the Society of Jesus, and has every facility for the thorough education and physical training of its pupils. In addition to the expenditure of $[illegible]0,000 in the erection of commodious buildings and improvement of the grounds, the sum of $10,000 has been expended in procuring a complete chemical and philosophical apparatus, which comprises many rare and expensive instruments, chemicals, &c., enabling them to illustrate the most abstruse principles of [illegible]

[illegible] College, also an artificial [illegible] of brick, 150 feet in di[illegible] [illegible] by an artesian well. [illegible] [illegible] are constantly being added, [illegible] altogether cannot fail to render [illegible] College the most attractive and [illegible] appointed institution in the State. [illegible] faculty and officers comprise a President, a Vice President, Chaplain, Treasurer, [illegible] Professors, and two Teachers, [illegible] others not enumerated. During [illegible] last session the whole number of students was 137.

The Academy of Notre Dame for young ladies, is situated in San Jose. It was established in 1851 by the Sisters of Notre Dame. There are about twenty ladies of the Order, from Europe and the Atlantic States, who have charge of the Institution and attend to all of the d[illegible] pertaining to its management. [illegible] of the buildings are of brick, and [illegible] construction. Extensive im[illegible] are in contemplation. The [illegible] and present edifices are valued [illegible]000. The Institution has at[illegible] a secure place in the confidence [illegible] people of this State. Its annual [illegible] at the close of each session, [illegible] of the Santa Clara College, [illegible] several days, and are attended [illegible] and visitors from the remotest [illegible] the State, who invariably ex[illegible] [illegible] satisfaction at the admirable [illegible] in which the exercises are conducted. The number of pupils during the [illegible] session, in all departments, was 15[illegible].

There are several other institutions of learning in this county, about which, [illegible] to recent changes made in their management, I have been unable to obtain reliable information. The University of the Pacific and the Female Seminary conducted by Prof. Rogers, may be mentioned, both at Santa Clara, and represented to be in a flourishing condition; especially the latter, which has been but a short time under the direction of its Principal.

I will add that two new Public School houses have recently been erected in this city, at a cost of about $1,800 each, of very excellent style and finish, and forming a pleasing contrast to the edifices formerly occupied by our public schools. The whole number of children in this county, between the ages of 4 and 18 years, is 1919; 1018 boys, and 901 girls.

I am under many obligations to Hon. Sherman Day, for information and suggestions, relative to matters alluded to in this report; Gen. W. C. McDougal and Mr. D. N. Phelps, of San Jose, will also accept my acknowledgments.

In closing, permit me to add, that my engagements would not allow of my making this report at an earlier date.— All of which is submitted,

Very respectfully,
[illegible] T. Healy,
Surveyor of Santa Clara County.

SANTA CLARA COUNTY
FLOOD CONTROL AND
WATER DISTRICT
MAR 31 PM 1 56

ALVISO, CALIFORNIA, JANUARY 1, 1952